Charles F. Rowe
Feb 1885.

BODILY DEFORMITIES.

BODILY DEFORMITIES

AND THEIR

TREATMENT

A HANDBOOK OF

PRACTICAL ORTHOPÆDICS

BY

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WITH 228 *ILLUSTRATIONS*

PHILADELPHIA

P. BLAKISTON, SON AND CO.

1012 WALNUT STREET

1885

PREFACE.

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THIS work is the first of a series which was projected some time since, and is, I believe, the original instance of a collection of monographs on the various departments of Surgery, Medicine, and Gynecology of a comprehensive and concise character, at a reasonable price, intended for publication in this country. That the idea is a good one is evidenced by the announcement of a similar series some time after the present one was arranged.

With the exception of works on some of the sections of Orthopædic Surgery by well-known Orthopædic veterans, no book of an authoritative character, *i.e.*, founded on a large, special and general experience, has, for many years, appeared in Great Britain. Indeed, so far as I know, there is no work in any language dealing with orthopædics in its modern sense. This gap I have endeavoured to fill, and though no one can, or should be, more conscious of the difficulty of doing justice to a rapidly-growing surgical specialty than the author, yet—if he like his subject—his labour becomes lightened by the reflection that honest work, however imperfect, will meet with its meed of appreciation in candid minds.

It will be observed that I have omitted any detailed account of joint diseases and other subjects, such as hare-lip, cleft-palate, and plastic surgery generally, which, though properly included by some writers as orthopædic subjects, are large enough to claim a volume to themselves in this series.

The general results of my experience at the Royal Orthopædic Hospital for many years have been included in these pages, and I am preparing a statistical account for separate publication.

Some subjects quite new to British Surgery will be found in this book, and I would refer to the chapters on Spring Finger and Paralytic Dislocations as corroborative of this statement. I have also endeavoured to do justice to the pathology of my subject. A new and successful operation for nasal depression, with suggestions for another on the nasal bones, are noteworthy points. I have found it necessary to adopt a more correct and natural nomenclature and classification of club-feet than is in vogue, and such a proceeding should need no further explanation.

The illustrations, with the exception of those representing instruments, have been taken from my cases or photographs, and it would have been easy to have increased their number, but I preferred to select typical or remarkable cases. Most of them were drawn by Mr. D'Alton; some by students at the London Hospital, and a few by Mr. E. N. Smith. I beg to thank these gentlemen for their accuracy.

I am indebted to Mr. Schramm for the use of a large

number of blocks of instruments, and to Messrs. Mayer and Meltzer for the blocks of tenotomes and the osteotome.

The work has been written from the standpoint of a general surgeon interested in a special domain of surgery, and I trust I have shown that success in the treatment of orthopædic cases depends very largely on extensive experience, personal supervision, and watchful care.

Though I have found it necessary to differ, here and there, from the views of other workers, I hope I have done so with the recollection that we have the common object of doing our best to advance the science and practice of an important domain of surgical work.

78, Grosvenor Street, W.

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PART I.

INTRODUCTORY OBSERVATIONS.

CHAPTER I.

Definition.—*Orthopædics*, or *Orthopædic Surgery*, is that branch of practical surgery which deals with the correction of bodily deformities, from whatever cause arising. The term *orthopædic* is derived from two Greek words signifying, to educate or put straight, and the term *orthomorphic* has also been used to signify this branch of our art which puts parts into their straight or correct form.

Scope.—In its widest sense orthopædic surgery includes the treatment of all deformities to which the human frame is liable, but custom, and the practice of special institutions, has limited the grasp of the subject to the treatment of the various maladies discussed within these pages. Some authors, however, have included in it many branches of general and plastic surgery, such as the correction of squint, hare-lip, spina bifida, imperfect rectum, cleft palate, &c.; and though these undoubtedly are deformities, it seems to me that the subject, as generally understood in this country,

is large enough in itself without unnecessarily encroaching on other surgical domains; so that I shall confine myself chiefly to the consideration of the pathology, diagnosis, and treatment of the deformities of the spine, and of the lower and upper limbs. The branches of surgery just alluded to will be treated in other volumes of this series.

It seems scarcely necessary to define the term *deformity*, but it is well to say that, as a general term, it includes all deviations from the natural form of the bodily parts, whether congenital, or acquired by disease, accident, or surgical traumatism.

Those interested in the *history* of orthopædics will find valuable information in the "Histories of Medicines and Surgery" of Hæser, Daremberg, Rochard, and others, and also in various orthopædic works; such as those of Bauer, Sayre, St. Germain, &c., but it is beyond the scope of this practical series to give even a sketch of this interesting subject.

General Remarks on the Causes of Deformities.—The conditions producing or favouring deformities are various, but may be classified into *congenital* and *acquired*. Of the former the varieties of club-foot are examples, as also are congenital rickets, intra-uterine fracture, etc. These congenital cases may be divided into *mechanical* and *nervous*. The mechanical view, *i.e.*, the causation of club-foot and hand, etc., by position in utero is again gaining favour, as against the view that these conditions are due to contraction, spasm, or paralysis from disease of the nervous centres or nerves. Excess or defect of development is also a frequent cause of malformation, as instanced in supernumerary or deficient digits, hare-lip, cleft-palate, etc. Other familiar instances of defect are *spina bifida*, intra-uterine amputations, and cleft-palate or bladder. Partial absence or defect of some part of the body, as of the

limbs, also occurs, and certain defective, or otherwise abnormal conditions of the joints, are known under the name of *congenital mis-placements.* Mr. Roger Williams has recently shown at the Pathological Society a case in which the femora were absent, and Mr. John Wood has also recorded another instance. This, like most similar deformities, is irremediable. Intra-uterine amputations due to strangulation of the limb by the umbilical cord also occur, but are of course only to be treated by artificial limbs when the patient is old enough.

Among the *acquired* causes are injuries, such as fractures, dislocations, diseases of joints—whether traumatic, gouty, syphilitic, or rheumatic—rickets, osteo-malacia, inflammatory overgrowth of bone, etc. Contractions of the skin, ligaments, and fasciæ will also produce deformity which is often severe; and the opposite condition of these parts, viz., relaxation through deficient support, may lead to the production of various distortions. Disease of the nerve centres and nerves, whether irritative, causing spasm and contraction, or paralytic, is a not infrequent cause of such cases as the orthopædic surgeon has to treat.

Among the causes due to the *nervous system* we have both classes, the congenital and the acquired. These may lead either to active spasm, or passive contraction of the muscles. The causes producing the former are lesions of the nerve centres or trunks, which may be direct or reflex. Among the latter are some forms of congenital club-foot, and the acquired forms which are more or less due to unbalanced action of opposing muscular groups, as also are the various paralytic deformities, the distortion occurring towards the side on which the muscles are active. The muscles themselves may, through injury, disease, or long rest in an abnormal position, produce various degrees of deformity.

Acquired deformities due to cerebral mischief are generally met with in orthopædic practice in the stage of secondary rigidity, as in cases of hemi- or paraplegia. This condition appears to be due to degeneration, passing down the cord from the seat of brain lesion and along the pyramidal tracts. In cases of *hemiplegic rigidity*, the shoulder is raised and each arm held firmly to the side, the elbow and wrist are flexed and the fingers clenched, while the leg is in the opposite condition of extension, the knee being straight and the toes turned towards the ground. In such cases all or most of the muscles are involved in the spastic condition, as proved on passive motion, though it would seem at first sight as if only the flexors of the upper, and the extensors of the lower limb were affected. Infantile hemiplegia is commonly due to a cortical lesion, and instances of congenital hemiplegia are pathologically similar; and, as secondary descending degeneration of the pyramidal tracts occurs in these cases, rigidity of the affected limbs is almost always present.

Spinal spastic rigidity is usually accompanied with motor paralysis in the limbs, and extreme muscular spasmodic rigidity, which is not relaxed during sleep. The limbs may be either flexed or extended, and in some instances there may be alternations of these positions. The malady is due to fibrous hardening or cirrhosis of the lateral columns; but there are mixed cases in which these columns are more or less affected in union with some other part of the cord, as in the stiffness sometimes found in paraplegia from spinal osteitis.

Hysterical spasm is of importance from a diagnostic and therapeutic point of view. It may affect any part of the body, but especially the limbs, the lower more often than the upper, and it may involve one set, or various groups of muscles, or the entire limb. Some of these contrac-

tions are quite extreme, and even under an anæsthetic they are not always reduceable; but this generally occurs in cases of long standing, in which shortening of the muscles has taken place. Sir James Paget's Clinical Lectures, and the little work by Dr. Shaffer of New York on "The Hysterical Element in Orthopædic Surgery" may be advantageously consulted from a clinical point of view.

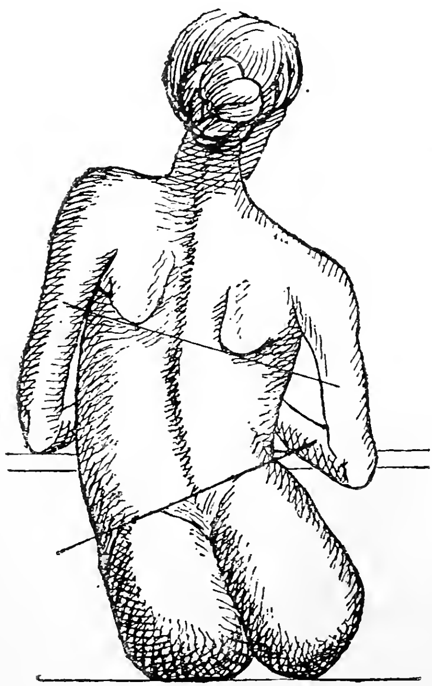


FIG. 1.—Left improper writing position in a girl.

Reflex spasm is rarely of a permanent nature. It may be due to the irritation of worms, which may cause squinting in children, or it may be due to dental inflammation, or to facial neuralgia. In the limbs, permanent contraction arising from this cause is quite exceptional. Chronic torticollis and strabismus may be reflex or direct, and in the latter case the pathology is not yet clearly made out.

The conditions producing passive non-spasmodic muscular contraction will be found sufficiently given in the sections on causes in the various chapters in this work.

Prophylaxis of Deformities.—This can, of course only apply to acquired distortions, and consists in the prevention of abnormal positions in the spine and limbs when enfeebled or diseased. It may be *general* or *local.* The

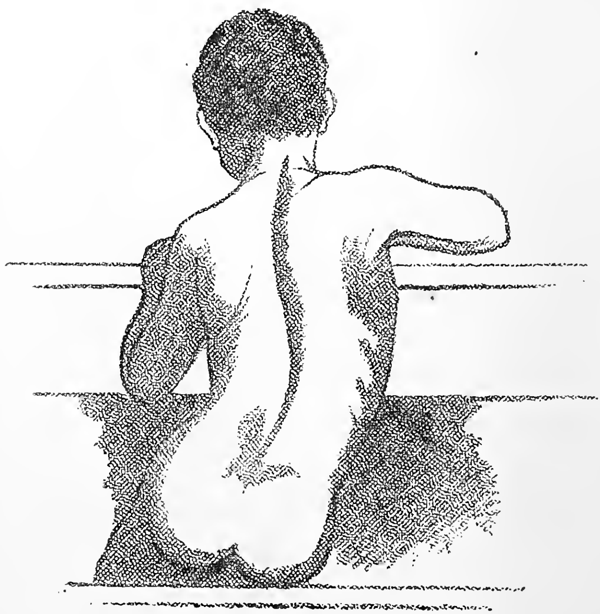


Fig. 2.—Right vicious writing position in a boy.

former consists in preserving and improving the health by all known means: as by good air, sufficient exercise and rest, morning baths, good nourishing food, regular meals, a proper mode of dress, and other well-known hygienic means.

The latter, as regards the spine, consists in seeing that children, and especially girls, do not assume vicious positions

in sitting or standing, and that while writing or studying at school, an improper attitude be not adopted, and become habitual. Weight-bearing in young growing folk, especially if on one side, is very prejudicial. The accompanying figures show improper and correct positions in writing.

Work and play should be judiciously intermixed, and out-door games, swimming, &c., for both sexes are very beneficial for the due development of all the muscles and viscera. Gymnastics, *general* and *local*, are valuable adjuncts in the prevention and treatment of deformities.

The recent conferences at the Health Exhibition have only resulted in the repetition of old truths, as this subject has been thoroughly worked out long ago; but, perhaps, the repetition of old knowledge may do good. Sir James Paget's objection to gymnastics, as a means of developing the body, seems to me a mistaken one; and we need go no farther than Germany—unless we would revert to ancient Greece—to prove the individual and national value of this excellent means of developing our physical powers.

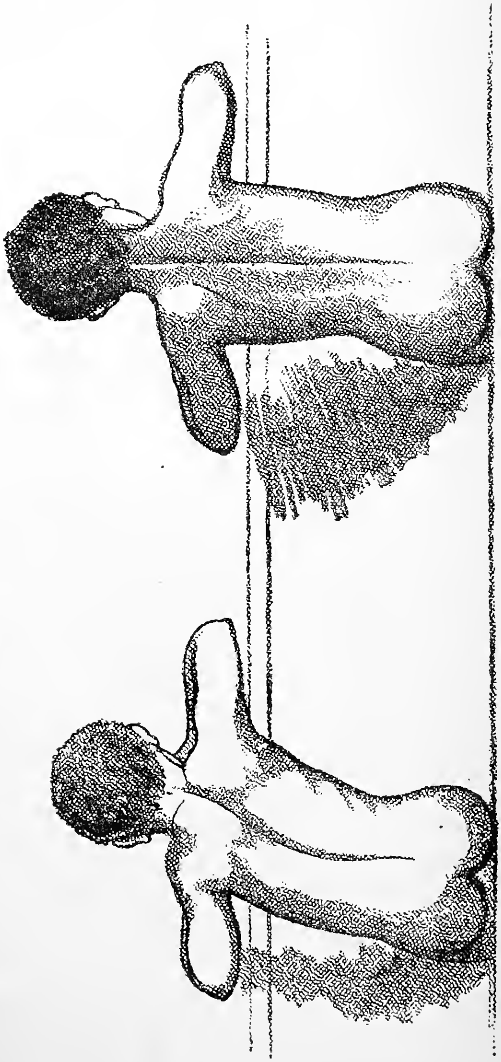
In the limbs, prophylaxis consists in so ordering habits of standing, and in so treating injuries and diseases of the joints and bones, as to prevent deformity, or minimise its effects if inevitable. Large scars resulting from burns must, by attention to position, and by skin grafting, be prevented from producing distortion.

General Remarks on Orthopædic Therapeutics.—The principles are few and very intelligible, and are these:—

1. To remove, if possible, the cause of the deformity.

2. Correction of the deformity through changing the position of the distorted bones, or through extension of contracted muscles and ligaments, or by division and subsequent extension of retracted muscles or their tendons.

3. To maintain the improved position and prevent relapse.



FIGS. 3 and 4.—Improper (to left) and correct position (to right) in writing or drawing.

Under the first head come all those precautions as to correcting bad habits of position in early life, and after-

wards, in occupations. Miners' lateral curvature, and bakers' flat foot, are instances of deformity produced by improper vocational positions, and by long standing and carrying heavy weights. In the limbs, fractures should be so set, and diseased joints proceeding to anchylosis so regulated, as to obviate deformity as much as possible, and to allow the limb to become fixed in a serviceable position.

The details of the second head will be found in the various chapters of this work. They may here be summed up by saying that they consist in—1. Bodily movements, active and passive; 2. Improvement of the general health; 3. Mechanical means, and by operative methods. These require no further explanation than will be met with in the following pages.

Under the third head are included the supervision of the case, the continuance of local and general measures used in the correction of the deformity, and the regular and judicious exercise, in its normal functions, of the part which has been restored to, or near to, its proper shape.

CHAPTER II.

RICKETS SURGICALLY CONSIDERED.

Definition.—Rickets is a peculiar constitutional malady, manifesting itself chiefly in the osseous system. As so many of the deformities, especially those of the lower limbs, are due to this condition, a work on orthopædics would not be complete without some account of it from a surgical point of view.

Synonyms.—Latin, *Rachitis; morbus Anglicus;* Greek, ῥαχῖτις-νοσος = a spinal complaint; German, *die Englische Krankheit; Doppelglieder; Zwiemuchs; Rhachitis;* French, *Rachitisme; maladie Anglaise.* The word *rickets* is probably derived from the Saxon *rick*, a heap or hump.

Varieties.—The disease may be *general* or *partial.* The local form occurs more commonly in adolescence or in later life. The general disease occurs usually in infants, the partial form more commonly in adolescents. Its manifestations may be acute or chronic. In practice we meet with three chief forms: (1.) Infantile rachitis, sometimes, though rarely, intra-uterine. The infantile form is by far the commonest; (2.) rachitis of adolescence, which in my experience is fairly common; (3.) senile rachitis, of which I have seen some well marked examples and drew attention to the subject in 1874.* Czerny† has shown that

* "London Medical Record," 1874, p. 142, etc.

† "Wien Med. Woch.," 1873, No. 39.

a disease which is practically rachitis, but which he termed *local osteo-malacia*, may occur in adults, and records the case of a soldier, æt. twenty-two, whose left leg was thus affected. Scoutetton* relates a similar case occurring in one leg of a tailor. Solly† relates two cases occurring in males, both aet. thirty. Mosetig‡ relates a case occurring in a male, æt. twenty-one, and called it *osteo-halisterisis* = partial decalcification. He states that the cartilage is normal. Weinlechner§ relates two cases occurring in the right legs of males æt. twenty-five and eighteen. The case which I recorded was certainly not osteo-malacia, and it occurred in a woman, æt. fifty. Both her legs were a good deal bent, the right began curving three years before she came to the London Hospital, and the left fourteen months before. Both tibiæ were much curved anteriorly and slightly externally. She was under observation for sometime and I was at first inclined to attribute the malady to that condition which is now better known under the term of *osteitis deformans*. For some months she remained under care, but the curvature did not increase in the right limb and only slightly in the left, and the pain first complained of had disappeared. She could walk fairly well when I lost sight of her. Though this case is deficient in pathological examination, still, in conjunction with some others that I have seen and been able to follow for some time, I think it not at all unlikely that regressive changes were occurring in these bones closely allied to rachitic processes.

Causes.—This disease is generally due to imperfect nutrition, and though insufficient and bad food, and bad

* "Gaz. Méd. de Paris."
† "Med.-chi. Trans." v. 27, 1884.
‡ "Wien Med. Presse," 1868, p. 89.
§ "Woch. d. Gesellschaft d. Aerzte in Wien," B. 25.

water are important factors, bad hygienic conditions, such as foul air, improper clothing, &c., are also active producers or inciters to the development of the malady. Heredity is in some cases strongly marked, while in others I have observed that several members of the same family have become rachitic though the parents were free from it. Illness or debility of the mother during child-bearing has an undoubted influence in producing the disease. Acute and epidemic diseases, and even chronic wasting maladies in children may lead to the production of bone curvatures. Poverty, with its concomitant conditions above enumerated, is a powerful factor, though the disease is not unknown among the well-to-do, as I have had to treat several children of parents in good circumstances. In such cases it is due chiefly to improper feeding, or to some derangement of the assimilative organs. Parrot thought that rickets was always caused by syphilis, denying that it could be produced artificially, though Baginsky, Roliff, and others, have shown experimentally that the deprivation of lime from the food of animals would produce slight rachitic changes, but that if lactic acid be added to the food while the lime salts be withheld, pronounced rachitis results. Baginsky* says that the disturbance of the general nutrition happens at a time when the growth of the bones is active, and this is why the bone change is the most prominent symptom. Tuberculosis and scrofula have usually nothing to do with the production of rickets, though they may co-exist.

Parts chiefly affected.—I have taken a thousand cases as perhaps a sufficient standard on which to found the following general conclusions, though in the course of seventeen years surgical practice I have seen very many more. In these I find that in nearly every case the lower ends

* "Trans. International Congress," London, 1881.

of the radius and ulna were enlarged, the clavicles were curved in 250, the humerus in 115, the radius and ulna, one or both, in 97. In these cases of deformity of the upper limb, the child was in the habit of crawling about, and in the few which the mother stated had not done so, the curvature was probably either due to muscular action, or to varying intensity of the disease at different portions of the bones. The ribs were very commonly found beaded, and in cases where the thoracic parietes were deformed they were flattened laterally, and the patient was affected with pigeon breast. The spine was affected, *i.e.* curved latterly, or was kyphotic or lordotic in 210. Lateral curva-

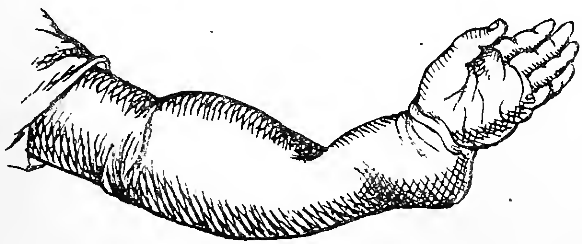


FIG. 5.—Rachitic deformity of forearm. The radius is acutely bent about its middle, the lower end of the ulna is enlarged, and the hand displaced to radial side.

ture was by far the commonest, then came lordosis, and kyphosis was the least frequent. The pelvis gave external evidence of deformity in all the cases in which the spine was affected, though the amount of deformity of course differed in various cases. In the few rachitic female adults whom I have had the opportunity to examine, the spine was externally deformed in all, and three gave accounts of difficult instrumental labours. In the lower limbs, curvatures of the leg bones and knock-knees predominated, the former being much the more common. The femur was more or less curved in 300 cases, and genu valgum or general bowing of the legs was present in 415 cases; the

malleoli were enlarged in 394; rachitic valgus was present in 294, and in infants the fontanelles were open in 755 cases, and closed in 210.

Symptoms and Diagnosis.—The patient is usually out of health with deficient appetite,. the temperature is raised, and there may be drowsiness. The bowels may be confined, or there may be loose greenish stools of a very offensive odour. These symptoms may lead to confounding the disease with the early stages of some exanthems, or with intestinal catarrh, with infantile remittent, or with the reflex irritation of teething, which, however, is not generally retarded as would be expected in this disease. Usually there is profuse perspiration of the head and upper portion of the body, and a general tenderness of the limbs and trunk. The abdomen is often prominent at a later stage, when the shafts and ends of the long bone are also very sensitive to manipulation. The ribs will soon be found to be markedly beaded, and the chest will be observed to be smaller, and the respiration more rapid. If kyphosis be early developed, the tenderness along the spine may lead to the supposition of caries, but if the child be lifted by the surgeon grasping the axillæ, the deformity will disappear if due to rickets; but in early stages of caries I have seen spinal rigidity disappear when extension, after the manner described, has been kept up a few minutes. It must be borne in mind that caries and rickets may co-exist.

As soon as the child attempts to walk, it will, in many cases, be found that it tumbles about, and children are commonly brought because they are backward in walking; should they be strong enough to bear the weight of their body, they totter along, and the bones of the lower limbs soon become curved; but in other cases, curvature occurs some time after the child has commenced walking. So-

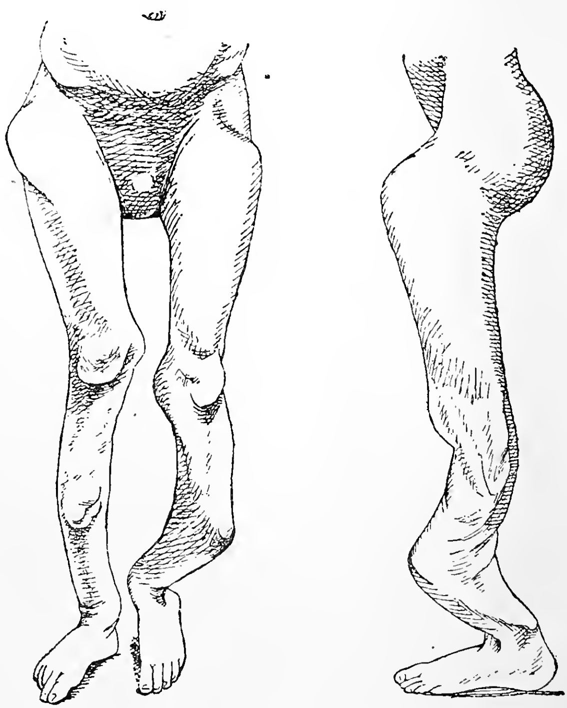
called *growing pains* are often observed in various parts of the body, and especially in the limbs: most markedly so about the knee-joint. These pains in the lower limbs are sometimes so severe that they may be mistaken for commencing ostitis or arthritis, and if the child has, as is not uncommon, had a fall, the surgeon may be deceived into regarding the case as due to injury to the bones or joint. Greenstick, or rachitic fractures, commonly occur after comparatively slight accidents.

Pathology.—As the orthopædic surgeon has to do with the correction of deformity, it is only necessary here to record what is at present known of the changes in the bones only. These have been divided into three stages. In the *first* there is *rarefaction* and *effusion*, and the bones generally, and especially the long bones, are infiltrated with a blackish bloody matter; but there is not as yet any external deformity, though the osseous tissue is rarefied and softened, and can be easily cut.

In the *second* period the deformity begins, and there is swelling of the epiphysis, and curvature of the diaphysis. The former is due to the presence of a spongy cartilaginous tissue, the histological characters of which must be sought in the various works on surgical pathology. The latter are caused by changes in the compact tissue of the diaphysis, which become more and more spongy, and at a late stage become converted into thin friable concentric layers, separated from each other by a soft and vascular connective tissue.

In the *third* stage, if the patient survive the rachitic marasmus, the bones become consolidated and eburnated, so that the bone is much more dense than that of the former compact tissue. Deformities of the spine, pelvis, thorax, &c., which have appeared in the second stage, now become fixed, and if seen at this period they are usually

found to be beyond surgical correction; but it is quite otherwise in deformities of the limbs. In the upper limbs, the curvature does not usually interfere with the usefulness of the member, though in some instances severe deformity may be rectified with advantage to function; but in the lower limbs, the body-weight often produces great deformity,



FIGS. 6 and 7.—Severe rachitic deformity of lower limbs. Anterior and lateral views. From casts in the London Hospital Museum.

which seriously interferes with the appearance and locomotion of the individual. In children from three to five years of age, the deformity is usually limited to certain bones, such as the leg bones and femur; but in older children, and in adolescents, it manifests itself at the epiphyses, which be-

come joined to the shaft at a later period in life, such as the lower epiphyses of the femur and upper of the tibia.

In addition to the general changes in the bones and cartilages, already described, it will be observed that if a section be made through the length of a long bone, the medullary canal will be found contracted at the middle portion of the bone, and enlarged at its ends. Sometimes it is dilated in its whole extent, and in other instances it is prolonged up to the epiphyses. In bad curvatures it is no longer central, but nearer the convexity of the bone, being only separated from its surface by a thin layer of compact tissue, or it may often communicate with its surface. On the concave side the bone increases considerably in thickness by the formation of new sub-periosteal layers, which Virchow has termed *osteoid tissue.*

Prognosis.—This has reference to the age of the patient, and to the probability of rectifying the deformity. It is only in infants and quite young children, and in the severe and acute forms of the disease, that a fatal result has to be feared, either through marasmus, or some of the well-known complications of the disease. After this period, and provided that thoracic deformity be not so extreme as to interfere with the functions of the heart and lungs, there is no risk to life. Patients may live to a ripe old age though much deformed. As regards the correction of rachitic deformity, the brilliant results of bone surgery of the last few years permit us to promise very much to the patients. We can often, in the second stage, by correct general and local treatment, not only prevent deformity, but straighten bones which are already bent or bending, by manual and instrumental means without operation; and in the third stage, we can by osteotomy or osteoclasy, fracture the limbs and reset them in a proper position; so that the prognosis, as regards deformity is, in the large majority of cases,

very favourable, but it must be borne in mind that secondary deformities may result, as shown in the annexed figure, where the lateral curvature was not rachitic in origin, but due to a long standing rachitic genu valgum. Hence the

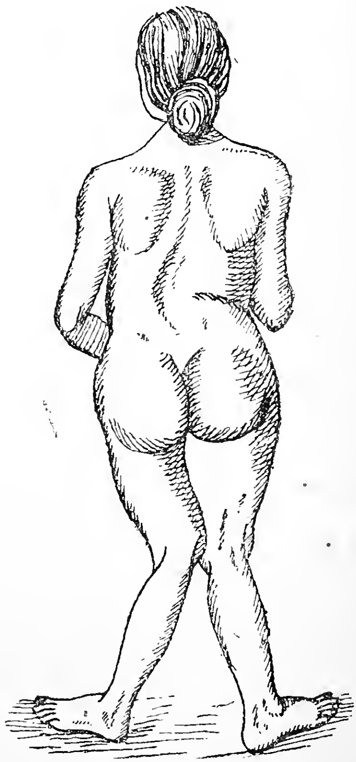


FIG. 8.—Lateral curvature in a girl aged fifteen, secondary to old genu valgum.

importance of correcting deformities of the lower limbs as soon as possible.

Treatment.—This is divisible into general and local; the former consists in removing any of the bad hygienic surroundings of the patient, and in the adminstration of proper diet and medicines: such as cod liver oil, and lime

salts. Kassowitz has recently stated that phosphorus, one part in 10,000 of olive or cod-liver oil, will cause craniotabes to disappear in from four to eight weeks, and that laryngeal spasm in cranial rickets becomes less frequent in a few days, and ceases in a few weeks. Also that marked lateral curvature disappears in a few months, and that children who for years have not been able to stand, will in the course of one or two months be able to support themselves and walk about. If these statements prove even approximately correct, a great therapeutic advance will have been made.

Disorders of the digestive apparatus are often relieved by grey powder in small doses. If cod-liver oil cannot be taken it may be rubbed in. Flannel or wool garments should be worn next the skin, and the children may be daily bathed in tepid sea-salt and water, or in sea water. In the second stage, as well as in the first, the patient should be kept as much as possible in the lying position, so as to prevent deformity of the limbs through the body weight. In many of these cases, well padded and properly applied splints will enable the children to take some exercise and get into fresh air, which is an undoubted advantage; but if after a trial of these means, the deformity show signs of increase, absolute rest should be enjoined, and especially in girls, as standing and walking in them may produce pelvic deformities which may give trouble in later life during parturition; but it must be recollected, as Mr. J. Wood has pointed out,* that even in the recumbent posture the pelvis may become deformed if it be much softened. In boys, progression may be allowed much more freely than to girls, provided the limb deformity is not increasing, for any resulting deformity of the pelvis is, in them, not usually a serious matter. In

* Article—Pelvis, Todd and Bowman's "Encyclopedia of Anatomy and Physiology."

patients whose parents can afford a light and effective apparatus, extending from the pelvis to the boot, I think the results are far better than with the use of ordinary side-splints; but even with the latter we may not infrequently achieve considerable success, though it must not, in this connection, be forgotten that a certain small percentage of cases become perfectly straight without the use of any retentive apparatus.

In the *third stage*, that of consolidation, operative interference is the only mode for correction of the deformity, and here the question of choice is between osteotomy and osteoclasy. These are sufficiently discussed in a later part of this book. As to the age in which it is necessary to operate, my experience is that age of itself is no certain guide, the best test being the condition of the bones. I have seen many children between three and four with firmly set bones, and have had great difficulty in penetrating them with a chisel, while in some others from five to ten years of age the bones have been a good deal softer. I am guided by the state of the bones, and the amount of the deformity; and in seeing cases for the first time I usually, as a matter of routine, advise the trial of splints, but if not enough beneficial change result in two or three months, I at once resort to operation.

PART II.

DEFORMITIES OF THE SPINE AND TRUNK.

CHAPTER III.

EXAMINATION OF THE SPINE.

Essentials of Spinal Anatomy. — *The Spine* is a flexible and strong column susceptible of various movements, and acts as the column of support to the head and upper limbs, and transmits their weight, as well as that of the head, neck, thoracic and abdominal viscera, through the pelvis to the lower limbs. The ribs are attached to it, and numerous muscles are connected with the vertebral processes and bodies which help to form it, and the function of this arrangement of numerous joints and muscles, is to give great mobility combined with firmness, and with the aid of the ligaments, to fix it for any desired purpose. The elasticity of the vertebral column is due to the intervertebral discs, and to the spinal curves, which, if seen from the side, present a cervical and lumbar anterior curvature, and a dorsal and sacral posterior curve. These vary somewhat in different individuals, and are due, in part, to the varying shape of the vertebral bodies, or intervertebral

discs. At birth these curvatures do not exist, but as the child begins to sit, or stand and walk, these begin to be formed. There is, however, a general posterior curvature when infants are supported on their buttocks, but this is due to spinal weakness, and the inability of the child to hold itself erect. The intervertebral discs are twenty-three, and form nearly a fourth of the whole length of the spine. If they be removed, and the vertebræ articulated, the cervical and lumbar anterior curvatures nearly vanish, and the spine appears to present but one great posterior curvature, the most prominent part of which is just below the middle dorsal region, and resembles, not a little, in shape what one has observed in senile cyphosis, which latter is probably due to shrinking, or other pathological changes of the intervetebral substances. These discs are highly compressible, losing about three-quarters of an inch during the day-time, but recumbency from six to eight hours, allows them to again become extended.

The *movement* of the spinal column is most extensive in the cervical and lumbar regions, and in the latter, motion is freest, consisting of anterior and lateral flexion, extension, and some rotation. In the neck, antero-posterior flexion is not so free as in the loins, though lateral flexion and rotation are greater. The spinal ligaments, especially the ligamenta subflava, which unite the laminæ, assist in maintaining the natural spinal positions. The ligaments just mentioned are stretched during flexion, and help to restore the spine to the erect position during extension, but there can be little doubt that the muscles are the active structures in maintaining the spine erect, though whether by *active tension*, or, as Mr. Adams has it, by *vigilant repose*, is not yet thoroughly established. As regards the production of the different forms of lateral curvature, there can be no question that muscular action, or lack of it, has been

exaggerated, and too little attention paid to the condition of the bones, intervertebral substances, and statical conditions in the production of these deformities.

Examination of the Spine.—This is done by *inspection*, *palpation* and *mensuration*. The patient should be nude to just below the iliac crests, and should be placed so that the light falls upon his or her back, and may be examined in the erect and sitting postures. In the former, the heels should be touching and the toes slightly everted, the head held straight, and the arms hanging naturally at the sides; the surgeon's eye having observed the chief deviations, his finger should then be passed down the course of the spinous processes, and if this be done two or three times, a red line will appear giving a tracing of the curves formed by them. In severe cases of rotation, care should be taken not to confound the apices of the transverse with those of the spinous processes.

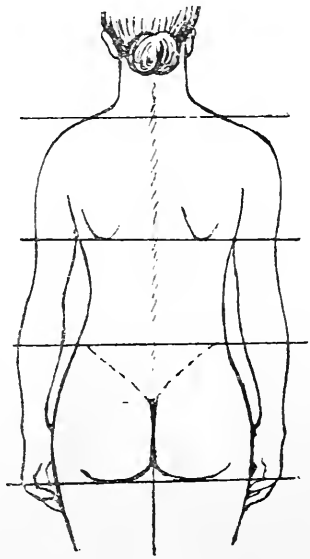


Fig. 9.—Diagram of the normal posterior aspect of a well-formed female trunk.

This being done, the patient should be made to gradually stoop forwards, and to bend the spine laterally in both directions, as by these motions any alteration of the curvature will be noticed. If necessary, the patient may be requested to lie in a prone position, and the spinous apices again traced to see if prone recumbency make any difference.

The accompanying figures will serve as useful guides to the surgeon. Fig. 9 shows the normal position of the

shoulders, lower angles of scapulæ, iliac crests and fold of buttocks, which, and especially the first three, become altered in relation in spinal curvatures.

Fig. 10 will be found serviceable in diagnosing which vertebræ are affected in Pott's disease, and if it be recollected that the spine of the fifth lumbar vertebra, is a little below a

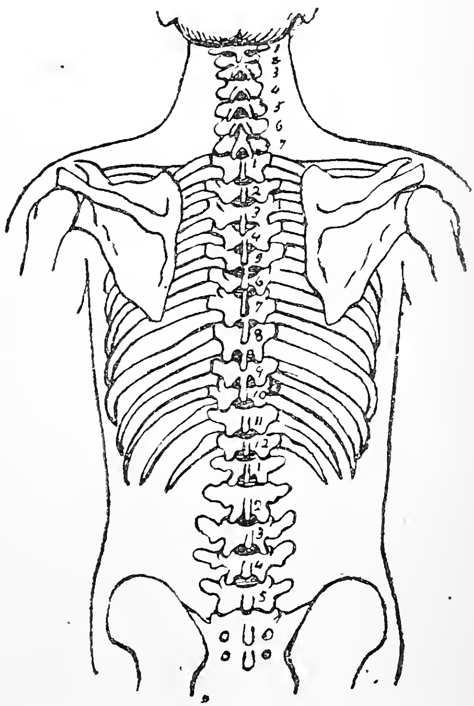


FIG. 10.—Diagram of the vertebra from behind.

line joining the highest points of the iliac crests, and if the surgeon count upwards, no difficulty should arise. The last rib will, if followed obliquely upwards, guide to the twelfth dorsal, and the vertebra prominens is the landmark to the lower limit of the cervical portion of the spine.

I have so frequently observed how inaccurately cases are

recorded, being simply registered as lateral curvature, or Pott's disease, without any indication as to the exact seat of the deviation, that for the purpose of surgical accuracy, I have inserted the above figures and explanation.

These methods will indicate to us the nature and situation of the chief curve, and of a secondary one if present; but for the accurate observation of the effect of treatment it is necessary to have some reliable record, or, in other words, to *measure the amount of the deformity.* For this purpose various means and apparatus have been devised, the simplest of which appears to be to allow a plumb-line to hang from the region of the upper cervical vertebræ, and a slight deviation from this right line will soon become apparent, and can be measured by an ordinary rule, and recorded; but to be more accurate we can take a tracing by means of the apparatus illustrated in the annexed figure, or we can measure accurately by Mikulicz's Skoliosometer.*

Bühring's apparatus consists of a glass plate 16 inches by 20 inches, fixed in a moveable frame attached to two uprights; the plate is divided into half-inch squares, and from the centre of the upper part of the frame, a plummet-line is suspended. At the side of the uprights, there is an arrangement to grasp the arms of the patient at the deltoid insertions, and at its lower part is a horizontal projection upon which a moveable dioptor is fixed upon a vertebral staff. This simple instrument is placed towards the light with the patient behind it, and the glass-plate is adjusted so as to cover the entire trunk. The arms of the patient are then fixed, and the patient is made to stand with his spine in the mid-line of the plate and with his heels together. A

* Last winter an instrument termed a *spinometer* was shown at a meeting of the Manchester Medical Society, but no description of it appears to have been published. The term is objectionable. *Rachiometer* would be better.

tracing of his back should now be made with some soft crayon chalk, or with some paint on a brush, and the plummet line is then allowed to drop from the seventh cervical vertebra, and by using the dioptor, the spinal curvatures and their deviations from the plummet line can be accurately noted. The patient is then released, and a piece of paper the size of the glass plate is put upon it, and a tracing made, and this can be kept for reference with any further tracings which the progress of treatment renders necessary. This plan, though giving the surgeon some trouble, is far less expensive and less irksome to the patient than the plan which was in use before it, of taking plaister moulds continually, or of taking repeated photographs.

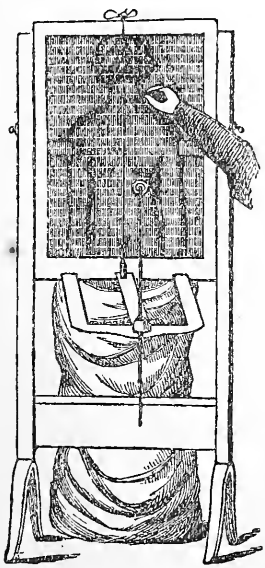


Fig. 11.—Bühring's apparatus.

Mikulicz's Skoliosometer* is an improvement on that of Bühring and Heinecke, as these had two serious drawbacks for practical purposes; they were too complicated, and required too much time and trouble to be used in ordinary practice, and they did not give reliable results in the various forms of scoliosis. They only gave the deviation of the spinous processes from the midline, but not a real idea of the actual deviation of the vertebræ, whereas Mikulicz's measures the torsion as well as the secondary thoracic deformity. The methods of Barwell and Sayre, by taking a sort of mould with a strip of lead, are subject to various

* Skoliosometer, ein Apparat zur Messung der Skoliose : J. Mikulicz. Centralblatt für Chirurgie, No. 20, 1883.

inaccuracies. With Mikulicz's apparatus one may measure —1. The height of the spine. 2. Its lateral deviation. 3. Vertebral torsion with reference to the whole thorax. 4. The position of the scapulæ. 5. The height of the shoulder, and 6, that of the iliac crests. It consists (*see* Fig.) of a vertical portion BB and a horizontal CC, the latter moving upon the former. The vertical portion is fixed to a metal arrangement BA, and to this is fixed a pelvic band GG. At A is a horizontally placed goniometer, and the portion BB is attached below to BA, and is so arranged that it can turn on a vertical axis to 180°. M is the indicator. If this apparatus be applied to a well-formed individual the indicator will appear at 90°, but every torsion of the body produces a deviation which may be read off on the indicator.

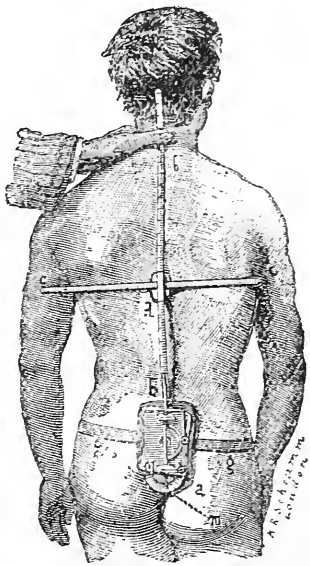


FIG. 12.—Mikulicz's Skoliosometer applied.

To measure *lateral deviation* the apparatus should be applied as in the figure. The pelvic band should pass above the trochanters, and the portion BA be actually placed on the middle of the sacrum; but if the pelvis be obliquely placed, the whole apparatus permits of a rotation on a horizontal axis, so that in every case the vertical portion BB can be brought into the position of the spinal column. The deviation of the pelvis from the horizontal in such a case can be measured with accuracy by the goniometer; but it is easier to do away with pelvic obliquity by putting something underneath the leg which produces it. The apparatus being applied, one then measures the

distance between two definite vertebræ of the upper and lower portions of the column, by means of the vertical BB. The best fixed points are the seventh cervical, and the first sacral. The lateral deviation should now be measured.

Before applying the apparatus in a case of lateral curvature, an ink or chalk mark should be traced along the deviated spinous processes; then the instrument may be applied, and, if the convexity be right dorsal, as is commonest, the apparatus should be pushed slightly to the left, so that the right edge of the vertical piece BB corresponds actually to the mid-line, that is to say, with the spinous processes of the seventh cervical and first sacral vertebræ. With the aid of the horizontal part CC, one may now read off the deviation of the vertebræ at the most prominent part of the curve. If the convexity be to the left, the apparatus should be shifted slightly to the right, and applied in the manner just described. For practical purposes it suffices to note the number of the vertebræ affected, and the deviation of the spinous processes where the curve is greatest. One must also observe the relative position of those vertebræ which lie between the primary and compensatory curves, and correspond accurately to the mid-line, and these vertebræ Mikulicz calls, the *resting-vertebræ*.

The *torsion of the vertebræ* must now be measured. In the previous measurements the arms were allowed to hang by the side, but now both arms must be raised, and crossed over the head as this raises the scapulæ, and the form of the thorax is made clearer. The horizontal part CC is now placed at various heights accurately on the back, and the deviations in the sense of torsion are then shown by the indicator M, but one must make sure previously that the metal-plate corresponds accurately to the frontal plane, for if the body be oblique the plate will rotate on a vertical axis, and the indicator will mark wrongly. The relative

positions of the shoulders, scapulæ and iliac crests can be ascertained by sliding the horizontal bar into the desired position, keeping the vertical one in the mid-line.

There can be little doubt we shall arrive at a more satisfactory conclusion as to the effect of treatment on cases of scoliosis, and be thereby led to improved methods of dealing with this malady, by the use of some reliable recorder such as that of Mikulicz, or any improvement upon it, and I make no excuse for drawing the attention of Orthopædic surgeons to its value. It can be procured of Mr. Schramm, 64, Belmont Street, Chalk Farm Road.

CHAPTER IV.

CURVATURES OF THE SPINE.

THESE may occur in a lateral or antero-posterior direction. The former are much the commonest in adults, and will first be dealt with.

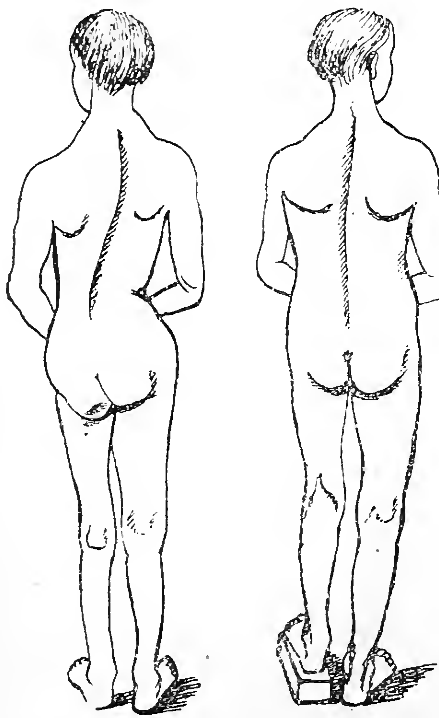
Definition.—*Lateral* or *rotaro-lateral* curvature of the spine or *scoliosis*, is a deviation from the normal shape of the spine in a lateral direction, and is accompanied, in almost all cases, with rotation of the vertebral segments.

Synonyms.—German, *Ruckgratsverkrummung oder Verbiegung, bogenformige Deformität der Wirbelsäule, Seitliche Verbiegung;* French, *Scoliose.*

Frequency.—Scoliosis is the most common, so called, *idiopathic* deviation of the spine, but it is not, as some have supposed, really more common than spinal caries. If the total number of cases of spinal flexure and disease be considered, general experience will, I feel sure, accord with mine, that though lateral curvature is more common in adolescents and adults than in children, vertebral caries is far more common in children than in adults, so that after striking a balance at all ages, the commonness of caries in children will counterbalance the frequency of lateral curvature in adults.

Varieties.—This affection may be *congenital* or *acquired;* the former being rare and the latter, as just stated, is common. The latter may also be *idiopathic*, *traumatic*,

rachitic, *inflammatory*, or *statical*, and it may be due to abnormalities of position habitually assumed by the patient, which lead to irregular distribution of pressure on the spinal column, and consequent deformity. Scoliosis may be *primary* or *secondary*. In the first instance the mischief originates in some of the spinal structures, and in



FIGS. 13 and 14.—Showing the production of lateral curvature by inequality in the length of the limbs, and the result of rectifying this.

the second case it follows irregularities in the upper limbs or in the body-supports, such as shortening of a leg from any cause. This deformity may either be *acute* or rapid and *chronic*, or slow in formation, and I have seen cases in which a pronounced curve developed in from three to four months.

Causes.—*Congenital scoliosis*, of which I have seen a few well-marked examples, may be due to initial debility of the vertebral structures, or it may be rachitic, or due to malformation of the bones, or to a bad position in utero. *Acquired scoliosis* is due, like most other affections, to predisposing and exciting or determining causes. Among the *predisposing causes*, *age*, *sex*, and *heredity* are important factors. Females are much more commonly affected than males, and this greater frequency seems to be due partly to the greater tendency to laxity of the ligamentous and muscular structures in the growing female, and partly to defective habits of standing or rather lolling, and partly to the drain on the constitution which menstruation induces in growing girls. The *age* at which the disease is most commonly noticed is, in my experience, from twelve to twenty-three or twenty-five, though it may occur sooner or later. Of course, I allude to the *incipient* stage of the disease, for, as is well known, a slight deformity may be overlooked and only come before the surgeon at a comparatively late stage when the malposition is more or less fixed. As regards *heredity*, there can be no question but that the tendency to the disease is propagated from parent to offspring; and I have seen, as before observed, congenital cases in which one parent only was

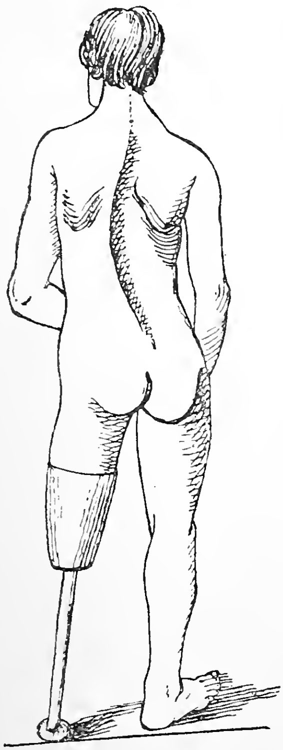


FIG. 15.—Lateral curvature, due to inequality and altered axis of support, from a patient whose leg I amputated some years before.

similarly affected; others in which several on one, or both sides of the parents' family suffered from a similar affection, and yet others in which there was neither history nor evidence of scoliosis in either of the parents, nor in any of the relatives. A feeble constitution is an important predisposing factor, whether congenital or acquired. If the former,

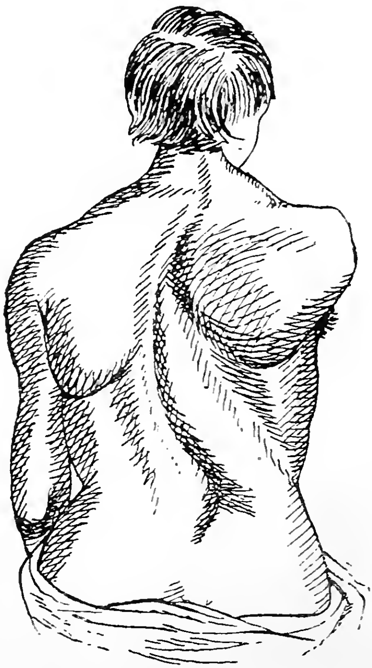


FIG. 16.—Lateral curvature, due to unequal weight on the two sides of the trunk, from a patient whose right arm I amputated at the shoulder for a machinery accident. The curve is towards the heavier side.

this cause would come under the head of heredity, though sometimes feeble offspring come from vigorous parents.

Among the *exciting causes*, bad positions, which children often assume at their studies in sitting or standing, are probably the most frequent; but in adolescents, and especially among the lower classes, the irregular pressure of weight-

bearing, or carrying, is a strong determinant of the disorder. The writing-desks at many schools, even now-a-days, are so badly constructed, and placed so low, that the children have to incline their spines, and the repetition of this evil position, though for a comparatively short time every day, will produce in time a deviation, and unless this deviation be observed early, and its cause removed, the curvature will become aggravated and even permanent. Young nurse-maids there are, who carry children always upon the same arm, and have to incline the trunk in the opposite direction to establish equilibrium, and thus they induce lateral deviation.

All causes, in fact, which induce a lateral inclination of the body, may produce scoliosis, whether they be weight-bearing or carrying, irregularity in the length of the limbs, or in the mode of standing; or whether the inclination be due to paralysis or contraction of the spinal muscles.

There is another important cause arising *within* the body which produces some of the worst forms of lateral curvature. I mean those due to *pleurisy* of one side, with collapse of the lung, and the presence of firm adhesions. This form, unless taken very early, is not amenable to any improvement. Severe burns of the thorax, resulting in large and dense cicatricial bands, may also produce lateral deviation. I must also draw attention to the fact that irregularity of position at the upper end of the spinal column, as in torticollis, or in bearing weights upon the head, may also produce lateral curvature; as may also inequalities of weight of the lateral portions of the body, such as the loss of an upper or lower limb; and I have often observed a *secondary* deviation in those who have worn an artificial leg, or a bucket and stump, for a year or more, and sometimes it occurs even in a shorter period.

Pathogenesis.—Various theories have been proposed to

explain how the different possible causes act in producing scoliosis. Some writers attribute it entirely to irregularity in muscular action, others blame the ligaments, and others the bones. Mayo thought that there was a defective growth in the muscles. Guérin thought that muscular retraction was the cause, and the German school, until recently, attributed it to muscular relaxation; but ana-

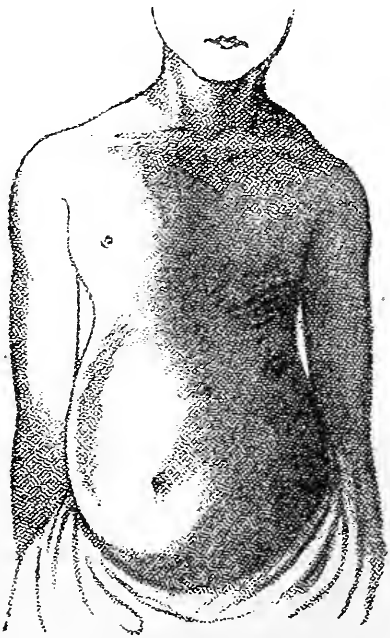


FIG. 17.—Left Pleuritic lateral curvature in a boy. Anterior view to show collapse of the chest-wall.

tomical, physiological, and pathological observations clearly show that these views are too exclusive. The same may be said of the view of Delpech, who attributed it to an engorgement of the inter-vertebral fibro-cartilages. I am now speaking of *primary* scoliosis, as those cases which are *secondary*, are clearly due to certain static and mechanical conditions which I will explain

presently. There is yet another set of rare cases which, so far as we at present know, are occasionally and undoubtedly due to a primary malformation, or ill-development, or absence of some of the vertebral segments, or parts of them and their articulations; and I am also convinced that not a few cases can be satisfactorily explained by altered growth, or ossification in the affected portion of the spine,

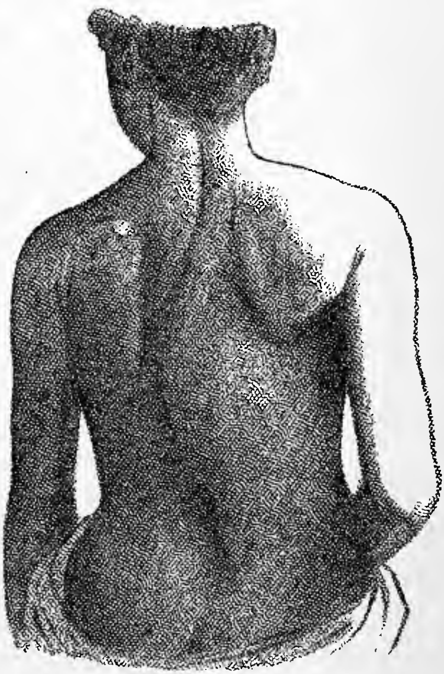


FIG. 18.—Left Pleuritic lateral curvature. Posterior view.

and I have seen such cases to which no other explanation would fit.

Malgaigne thought that lateral curvature was due to a relaxation of the peripheral ligaments of the spine, and that a feeble muscular system left to the ligamentous apparatus almost the entire task of sustaining the column, and these ligaments becoming incapable, the spine assumed a

curvature in accord with the position habitual to the body of the patient. The ligaments on the concave side become contracted, and maintain the deformity, whereas those on the opposite side become stretched and relaxed. On the concave side, the contracted ligaments produce pressure on the vertebral bodies and inter-vertebral segments, and produce in them consecutive absorption and alteration in form.

The Osseous Theories are three. Bouvier maintained that scoliosis was due to a defect in the plasticity of the bones, which rendered them more susceptible to yield under the influence of certain causes which are believed, or known, to aid in the production of the spinal curves, such as the beating of the aorta, the greater weight and exercise of the right or left limb, whichever happens to be the most used. Hüeter thought that this affection was consecutive to deformity of the ribs, and that these by their leverage produce rotaro-lateral distortion; but it is far more common for the ribs to become secondarily involved through a primarily spinal deviation. The third is the *statical* theory, which attributes the alteration in the bones to abnormal position of body-weight pressure, and regards the changes in the muscles, &c., as secondary to this.

There are other theories into which I need not enter; and though it must necessarily be some time before we get enough pathological material to definitely solve these important questions, I would state my conviction, from what I have observed in the living, and from the few *post-mortems* which I have been enabled to make, or see made satisfactorily, that in the stage in which pathological anatomy can speak from experience, we find all the structures more or less involved, muscles degenerated, bones deformed, inter-vertebral discs compressed, ligaments con-

tracted on the one side, and lengthened and degenerated on the other, and the joint surfaces altered. I have never seen an autopsy made in an incipient stage of the disease, and even if I knew that such an opportunity would present itself to me at once, I should not be at all sanguine of finding the *vera causa* of the disease, but should rather expect to find certain changes of shape, in an early stage, the causes of which would still remain doubtful. If, in the living, and even *post-mortem*, there existed marked deformity, and if there were no sufficient bony deformity to account for it, such a condition would naturally support the muscular and ligamentous theories; but if there were present marked bony deformity without any noteworthy changes in the muscular and ligamentous systems, which could not be correctly considered consecutive to the bony deformity, then the osseous theory would find some substantial support. I must now leave this part of the question, and content myself with stating my belief that in many cases the causes are manifold rather than single and simple; but I may just enumerate the various views which have from time to time been held, leaving their discussion for publication in another place.

Various views on ætiology.—The conflicting views which have been held at various times as to the cause of so-called *idiopathic* scoliosis are that it is due to—1. Traumatisms, luxations, &c.; 2. To congenital malformation of the spinal column; 3. To irregular distribution of weight on the two sides of the body, both as regards the viscera and the greater weight of the right arm; 4. To the pushing of the spinal column to the left through the aortic pulsations; 5. To paralysis of some of the spinal muscles or of the serratus magnus; 6. To debility and relaxation of muscles and ligaments; 7. To disturbance of the equilibrium of the muscles on either side of the spine (the antagonist

theory); 8. To primary abnormal bony growth of the ribs; 9. To fixation of a defective habitual or constantly repeated attitude; 10. To unequal, *i.e.* unilateral, pressure through weight-bearing on the head, shoulders, or arms; 11. To engorgement of the inter-vertebral fibro-cartilages; 12. Nicoladoni's recent theory, which regards torsion as apparent and due to a general optical impression caused by the high degree of asymmetry of the individual vertebra;* 13. To general, constitutional, or diathetic causes; 14. To vertebral articular disease; 15. To arrested or altered growth in the vertebræ. The last two are my explanations of some cases which have not been amenable to other hypotheses, and the articular cases furnished symptoms, such as localized pain on pressure and motion, and, in one case, abscess communicating with the costo-vertebral joint, which to me seemed sufficient evidence of the pathogenesis of the cases.

Diagnosis.—This comprehends three points: (1) to ascertain that lateral curvature really exists; (2) to determine its nature; and (3) to differentiate it from other diseases and deformities of this region. The means at our disposal are inspection, palpation, and certain instrumental aids already described. Of course when lateral curvature has arrived at a well-marked stage, it is easy to recognize it, but when the malady is incipient it is not such a simple matter. For instance, in cases in which the spinous processes retain their normal position, one has merely a prominence of one side of the back or loins, to indicate any deviation; and this sign, of itself, is not a certain indication of the presence of lateral curvature; but if it be accompanied by a projection of the opposite side, above or below it, this would show that deviation of the column had taken place. Even projection

* *Die Torsion der Skoliotischen Wirbelsäule, &c.*, 1882.

of the anterior or lateral thoracic parietes, only indicates scoliosis when there is a corresponding projection on the back part of the opposite side of the chest; but it should be mentioned that not infrequently there is a depression instead of a projection on the opposite side. If there be a deviation of the spinous processes the diagnosis is usually easy.

In cases in which there exists but one curvature, or in

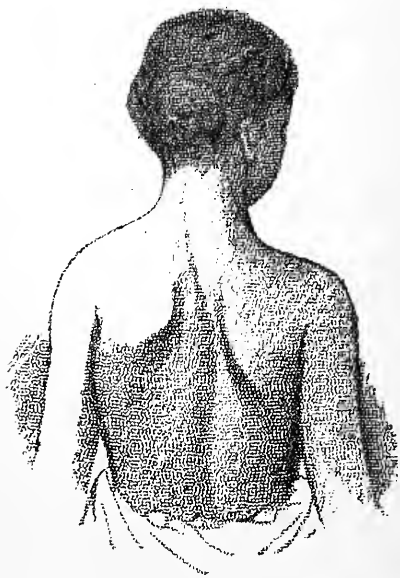


FIG. 19.—Defective development of left scapula, which is much smaller and on a much higher level than the right. Also slight lateral secondary curvature.

those in which the secondary curve has not yet had time to form, the diagnosis between rotaro-lateral curvature and a simple flexion, is not obvious, but it may help us to recollect, not only that simple flexion is not common, but that when it exists, it occurs most frequently in the more movable portions of the spine (the cervical portion excepted); that is to say, in the lower part of the dorsal, and upper part of the lumbar regions, and that the curve

of a flexion has a greater radius than that of a scoliosis. In severe cases of flexion, the skin and subcutaneous tissues are thrown into folds on the concave side, whereas in scoliosis there is usually a deepish groove, rarely more, on this side. It is uncommon for skin folds to exist in scoliosis, except in extreme cases, or in the later stages of the malady. These folds and grooves may be to some extent obliterated, by making the patient lie down, or by extension of the spine through suspension of the body by the occiput and chin, or by the arm-pits.

When the curvature is double, *i.e.*, when the *secondary* curve has formed, diagnosis is simplified. It is very rare indeed for a simultaneous double curvature to occur, and if there be three curves the diagnosis is easy, for the contracted muscles form projections which aid us, and the deviations of the pelvis, of the head, and of the shoulder-blades confirm the diagnosis. When rotation, *i.e.*, *torsion* of the vertebræ co-exists, there will be present, with the dorsal and thoracic projections, a deviation of the spinous and transverse processes and ribs, and all doubt will then be removed.

Sometimes with vertebral caries there exists a lateral curvature, but the history will guide us in these rare cases. In some cases it will be found that the scoliosis has pre-existed and been followed by caries, and in others that the carious vertebræ have subsided laterally, and when anchylosed, have formed a lateral curve at the site of the disease, or there may be a secondary lateral curve above or below the cyphotic projection. In these cases the lateral curvature is secondary, and in yet others, the cyphotic and scoliotic processes, appear to have come on together, but the lateral curvature progresses rapidly, and as a rule, its arc is less than that of an ordinary scoliosis.

The *hysterical* and *malingering* spine may be mistaken

for true lateral curvature; but the absence of secondary deformity and the presence of suspicious elements in the case, together with the use of anæsthetics, as well as the result of proper treatment, will aid us in coming to a correct conclusion. *Drop-shoulder*, *i.e.* the condition in which one shoulder is on a much lower level than the other, is not uncommonly met with in hysterical girls.

It will not be enough for us, as conscientious surgeons, to be satisfied with the simple diagnosis, but we must endeavour to ascertain the cause of the malady; that is to say, to

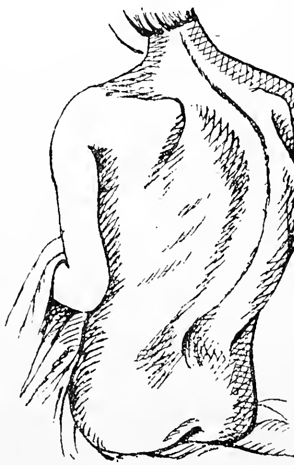


Fig. 20.—Congenital scoliosis in girl æt 3. No rickets.

form an ætiological diagnosis, and to ascertain whether the malady be symptomatic, or idiopathic and essential. I leave out of the present question the congenital and rachitic forms, for these obviously occur at much earlier ages, and in the latter, there are other evidences of rickets to guide us. If the curvature be symptomatic of a pleurisy, the collapsed state of the thorax on that side, combined with auscultation, percussion, and the previous history, will settle the matter. If the disease be *statical*,

i.e., due to mechanical causes, such as loss of a limb or inequality in the length of the legs, or to weight-bearing, the greater curve will be near the part causing it; for instance, if an arm have been lost at the shoulder, the curvature will be in the upper dorsal region on the *opposite* side, and if it be due to inequality in the length of the legs, the dominating curve is placed in the loins. Other diagnostic signs are given in the next paragraph.

Symptoms.—Though curious, it is however true, that this affection, which should be obvious to the eye, is rarely noticed at a very early stage, and even in those cases where pain in the back is complained of, it is attributed to something else. The first symptom which generally attracts the notice of the parents, or of the patient, is a growing out of the shoulder blade. I have seen several cases of marked deformity which have passed unnoticed, though the parents have been in the habit of frequently seeing their children in a nude condition.

The *subjective* symptoms are not usually strongly marked, but when present pain is the chief one, and is of a varying character, and commonly in the back and sides near the part affected; and there is a feeling of lassitude, as if the back required support, and the patients express themselves much relieved by sitting or lying. The *objective* signs are prominence of a shoulder-blade, generally the right, forming what is known to the public as "a shoulder growing out." On examination, it will be found that when this condition exists the curvature has become well marked, and this inequality of position of the scapulæ is due not only to the lateral spinal deviation, but also to the posterior projection of the ribs on the convex side of the curvature, so that the scapula is pushed out and back by the projection of the ribs. In mild forms of *simple flexion* or *inclination* of the spine, there is a difference in the position of the scapulæ, but it

is of a different character, being less pronounced and not giving the appearance that one shoulder-blade is larger than the other.

This sign of shoulder projection may occur in all dorsal deviations, whether primary or secondary, and will indicate the convex side of the curvature, that is to say, if the right shoulder project, the dorsal curve is to the right, and *vice versa;* and if the lumbar curvature, secondary to the dorsal, have formed, its convexity will be on the *opposite* side to that of the primary curve. In cases where the initial or primary curve is lumbar, and the secondary or *compensatory* curve is dorsal, the scapulæ may be on the same level, especially if the two curvatures have the same arc. In the lumbar region and at the hips, an opposite condition will be observed; for instance, in a *right dorsal* curvature, the hip on the *left* or *concave* side of the curve will appear more projecting, that on the right side being flattened or depressed, though there is really no difference in position between the innominate bones in ordinary cases. In cases where there is pelvic obliquity, whether primary or secondary, measurement will demonstrate that the anterior superior spines are on a different level, not only as regards height, but also in an antero-posterior direction; that is to say, torsion may be combined with obliquity of the pelvis. The reason for this apparent projection of the hip on the concave or opposite side to the curvature, is the depression which exists above it, obliterating the flank or loin, whilst on the convex side the line connecting the loin, hip and buttock is normal, though the parts just above the posterior part of the innominate bone on this side, especially the erector spinæ, are sometimes more prominent, forming a contrast to the groove or hollow on the opposite side.

Carrying the examination further, one will find that the

spinous processes have deviated from the normal mid-line, and in the case of a right dorsal curvature, the convexity of these will be to the right, and it will generally be found that cases of lateral curvature are exaggerations and extensions of the normal spinal curves. *Secondary* or *compensatory* curvatures, whether occurring in the lower or lumbar part, or in the upper or cervical-dorsal region, are always on the *opposite* side to the primary curve. The ribs on the side of the curvature are pushed back so that the shoulder-blade is forced out and its angle projects, whereas on the opposite or concave side, the scapula appears more or less flattened, and is more readily moved by the surgeon. Occasionally the inferior angle of the scapula on the convex side is not prominent, as is the rule, whereas on the opposite side it projects. In the first instance, this will depend upon the degree of the deformity of the ribs, the number of them displaced, and the position of this displacement. In the latter the projection of the scapula appears to be compensatory, and due to muscular action.

In extreme cases, or cases of long standing, the curves become increased and exaggerated until the patient has ceased growing, and even, in some cases, for some time after; and this is the case with the secondary as well as the primary curve, and so deformed does the spine become, that in some instances it requires care to differentiate it from a severe case of Pott's disease, as not only is there a very great posterior projection, but there is also formed an anterior one, usually on the opposite side—that is to say, on the left antero-lateral side of the thorax if the curvature be right dorsal. This anterior projection of the ribs and sternum—if the latter be affected—is less pronounced than the dorsal deformity, and it may, by the inexperienced, be confounded with rhachitic thoracic deformity, or even

with the chest deviation occurring in vertebral caries. In very bad cases the hollow in the flank beneath the projection is very narrow and deep, and I have seen cases in which the lower ribs not only touched, but over-rode the corresponding innominate bone, so that the fingers could not be passed between them. Sometimes this causes very great pain and inconvenience, which is very difficult to

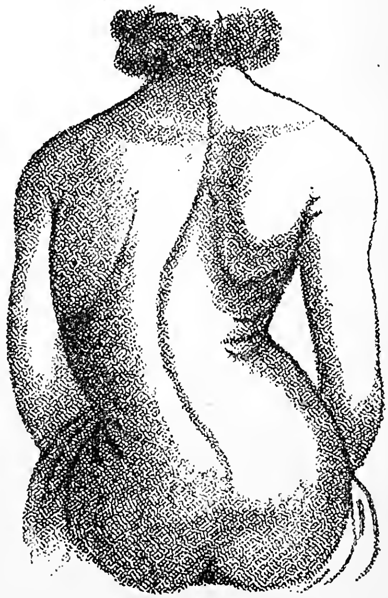


FIG. 21.—Left dorso-lumbar curvature, showing the falling-in and creasing of the right ilio-costal region, and the altered level of the scapulæ, shoulders, and hips.

alleviate. I may draw attention to a circumstance overlooked in all works on the subject—viz., to the existence of subcutaneous bursæ beneath these points of projection, and I have known these become very tender, and even to inflame and suppurate.

Many sufferers from severe lateral curvature carry themselves in a peculiar manner, appreciable to the experienced eye. They have what may be termed a *hippy* walk—that

is to say, one hip is much more prominent than the other, and even in sitting, this prominence is noticeable. This is due to pelvic obliquity, it being inclined towards the the convex side of the curvature, the corresponding lower limb being slightly flexed, and carried forward. The patients generally carry themselves so that the body is inclined to the side away from the deformity.

I may remark, in passing, on other supposed popular signs belonging to sufferers from spinal disease; these are bad and revengeful temper, great intelligence, and intense venereal capabilities; but I need scarcely state that such cases are exceptions rather than the rule. It is true that some sufferers from lateral curvature are bad-tempered, and no wonder; it is equally true that some are very intelligent, but I have found that sufferers from spinal caries commonly possess higher intelligence than those from lateral curvature, and I think this is to be partly explained from the well-known fact that tubercular people are often of very active mental habits, and partly by the fact of their illness and isolation throwing them more on their own resources, and inclining them to compensate for their physical deficiency by mental superiority. As for the last allegation, I can only suppose that to be true in cases where there is a chronic irritation in the lumbar portion of the cord. I cannot say, from actual personal experience, whether there is any truth in the statement as regards sufferers from lateral curvature.

The bony deformities are followed by changes in the soft parts and viscera which may aid in the diagnosis, and must be well taken into consideration in our treatment. In advanced scoliosis the *head* and *neck* are often drawn forwards, or to one side. This inclination is towards the concave side of the dorsal curvature if this be high, but sometimes they are inclined to the opposite side if the

curve be very pronounced. The *head* generally follows the direction of the inclination of the neck, but sometimes it deviates to the opposite side. The *abdomen* projects in front, and appears shortened, and often limited by a groove at its upper and lower parts. The *loins* are convex on the convex side, and concave on the opposite, and the distance between them and the hips is shortened, especially on the convex side, in consequence of the ribs being pushed

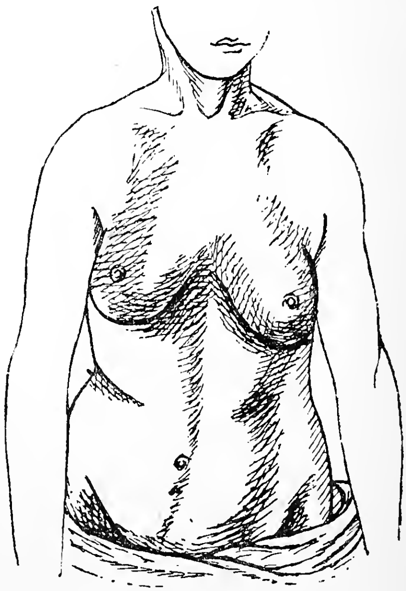


FIG. 22.—To show the deviation of the anterior mid-line of the body, and the altered position of the breasts in lateral curvature.

towards the os nominatum. The *hips*, as already stated, *appear* unequal, that on the convex side appearing flattened, and that on the concave being more prominent. There is also, in well-marked cases, a difference in the position of the breasts, the mammæ on the side of the antero-lateral thoracic deformity being thrown more forward, and somewhat displaced outwards and downwards, the mid-line is also deviated to the affected side.

Following the initial symptoms are languor, anæmia, general lassitude, and local pains, and, in proportion as the disease becomes more advanced, symptoms showing involvement of the thoracic and abdominal viscera, or of the nerves and muscular system, become apparent. There is more or less blood stasis in the venous system and right side of the heart, then dilatation of this side of the organ, palpitation, faintings, and sometimes nasal, gastric or rectal hæmorrhage. In females there is often an irregularity of menstruation and uterine displacement accompanying the pelvic deformity. *Pain in the back*, as women call it—that is, about the lumbar portion of the spine—is often due to uterine or rectal mischief, and must always be present in our consideration so as to differentiate these causes of pain from those due to lumbar caries or lumbar scoliosis; and one must also recollect that myelitis, meningitis, or tumours of this region of the cord may also cause pain, which is, however, of a much more acute and severe character. But when these latter diseases cause pain, they also give rise to other temporary or permanent symptoms such as tingling, twitching, or paralysis, which will aid materially in the diagnosis. The importance of having a large experience and knowledge of all branches of our profession before any one has a right to consider himself either a competent general, or special practitioner is, in such obscure cases, well exemplified. General knowledge, if sufficiently deep, cannot but make one a better specialist; whereas, however deep one's special knowledge may be, this of itself will only render one more unfit to be a good general practitioner.

It is almost always observed that patients with well-marked lateral curvature and thoracic deformity are very short-winded. They cannot go upstairs quickly, neither can they walk briskly, nor run, the vital capacity of their

lungs is diminished. This is partly due to the deficient mobility of the thoracic parietes, and partly to the diminished capacity of the lungs following the altered shape of the thorax. These changes in the lungs necessarily lead to secondary affections of the heart, such as I have just described, and these again re-act upon the lungs and also upon the abdominal viscera. In consequence of these changes in the heart and lungs, these patients are subject to bronchitis, congestion, and pneumonia, and they should be specially warned against sudden exercise, or extremes of temperature. It is very rare for these people to be good singers or public speakers, because of the physiological inactivity of their thoracic viscera, and not a few of them end in acquiring phthisis. Auscultation at the point where the thorax is *bossed* or *gibbous*, will elicit that the respiratory murmur is very feeble or even abolished, whereas over the rest of the chest it is increased, and even of a bronchial character, and percussion will elicit dulness on this side of the cavity, showing that the air-cells of this portion of the lungs are more or less effaced, and sometimes this dulness is due to pulmonary congestion, caused as has been already explained. In later stages these subjects become emphysematous, and are subject to the train of symptoms accompanying this condition of the lungs.

In severe cases the adjacent organs become involved, the liver is pressed upon, its action more or less interfered with, and, as a consequence, constipation is not a very uncommon concomitant of bad scoliosis. Indigestion is far more common, but, independently of this, these people are rarely large eaters, partly because of the compression to which their abdominal visceræ are subjected, and partly in consequence of their inability to take sufficient exercise to create a large demand for food.

As regards the *nervous system*, it is very rare to observe

anything serious, such as loss of motion or sensation through compression of the spinal cord, or of the nerves leaving it, but *neuralgia* is, however, common, and follows the course of the nerves issuing from the vertebræ affected.

The *muscular system* is enfeebled, the patients being

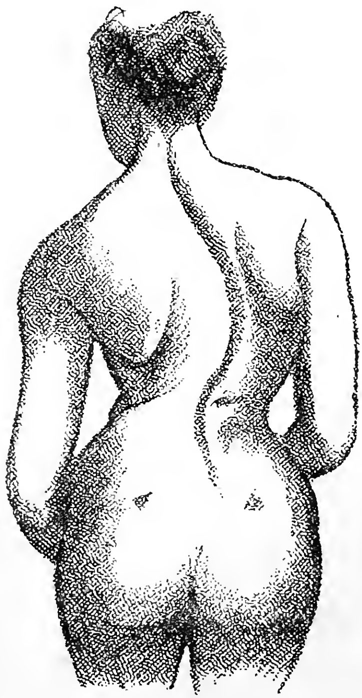


FIG. 23.—Right lower dorsal and left lumbar curvatures, showing unequal height of shoulders and foldings of the soft parts in the left ilio-costal region. The left hip is higher than the right.

unwell or unable to take exercise. The muscles which suffer most are the spinal, many of which become, after a time, fattily degenerated.

Pathological Anatomy.—At present, although there is enough material to guide us in coming to proximate conclusions as to the changes in the bony and ligamentous

structures, still the history of the changes in their entirety have yet to be worked out, and it will only be when a sufficient number of careful examinations of the various forms of lateral curvature in the incipient stages have been made, that the true pathology of this affection can be elucidated. I have only seen or made *post-mortems* in three cases of the ordinary, or so-called idiopathic form of lateral curvature, and in one of these the disease was in a rather early condition. The results of these examinations, with the observations of other workers, must form the basis of the following remarks.

Bones.—The *bodies* of the vertebræ, and the intervertebral discs are diminished in height, *i.e.*, compressed on the concave side of the deformity, and the amount of this decrease will vary with the amount of deformity. There is also a groove on the side of the vertebræ along the concavity. On transverse section the affected bodies and intervertebral substances have a wedge-shaped appearance, and if, before section, the vertebræ be separated from each other their upper and lower surfaces will be seen to be altered, being larger on the convex and contracted on the opposite side. In severe cases some of the intervertebral discs and adjoining vertebral segments have become absorbed on the side of pressure, and anchylosed. Delpech has described a lozenge-shaped depression due to rotation and torsion on an antero-posterior axis, so that a vertical transverse section of such vertebræ would, on account of the turning of the upper or lower surface towards the right or left, present the appearance of an oblique-angled parallelogram. In a similar section of the normal spine the geometrical figure is that of a right-angled parallelogram.

If the disease, commencing, as it usually does, at the age of puberty, be severe or have progressed rapidly, the process of ossification is interfered with on the side of pressure

but on the opposite side, excess of growth occurs. In such cases anatomical examination reveals well-marked changes in the other constituents of the vertebræ.

The *articular processes* are contracted, though elongated from above downwards on the convex side, whereas on the concave they are flattened out, and in severe

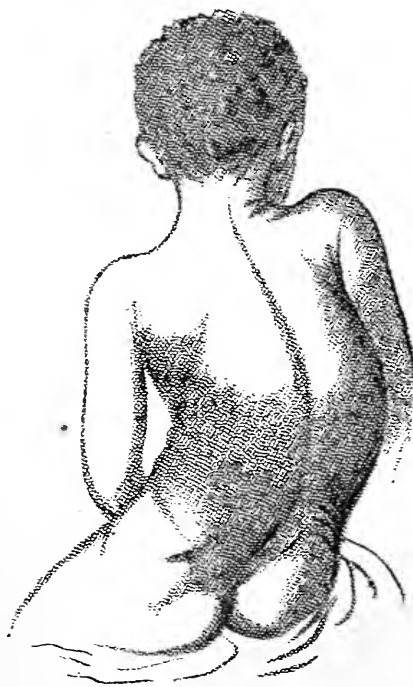


FIG. 24.—Paralytic general kypho-scoliosis in a boy aged three.

cases all semblance of joint structure has disappeared and they have become anchylosed. The *transverse* processes are altered in shape and direction, sometimes they have become joined to their neighbours, and occasionally they are elongated on the convex side. The *spinous* processes are variously altered in shape, and their apices are usually directed to the concave side, but sometimes in the opposite

direction. The *laminæ* are found to vary in different cases, being sometimes thicker laterally on the concave side, sometimes being smaller in all directions on the same side, and at other times there is no appreciable difference between the convex and concave sides. The *vertebral foramina* are sometimes much contracted on the concave side, and enlarged and triangular on the convex. The *vertebral arches* have their pedicles shorter on the concave side, and in extreme cases the articular processes are in contact with the vertebral bodies; in other cases the pedicles are altered in all their dimensions but without any great regularity.

Besides these changes in individual vertebræ, there exists a *rotation* and, in severe cases, a *torsion* on an antero-posterior axis of the affected vertebral segments, and the rotation has taken place around one or more of the articular processes as centres. This rotation varies with the direction of the curvature, as it takes place from the concave towards the convex side, and during life it would only be inferred by the experienced, as its effect is much less pronounced on the parts open to examination, such as the spinous processes and the vertebral arches, than on the bodies. This mixed rotation and torsion is most marked, as might be expected, at the most salient part of the curve.

Certain well-marked secondary deformities of the thoracic parietes are found in all well-marked cases of this distortion. In moderately severe cases, the ribs corresponding to the affected vertebræ become separated from each other on the convex side and the opposite on the concave, so that in severe cases they touch and even over-lap, and sometimes become anchylosed. They are displaced backwards on the convex side, and their head and neck are altered in shape; in severe cases the former is absorbed or anchylosed with the corresponding vertebra, and the angles and posterior

parts of the rib-arches form a projection at the back of the thorax which may be confounded with the deformity due to cyphosis, or to Pott's disease, but differs from them in that the protuberance of the latter is more or less in a line with the vertebral segments, whereas the costal scoliotic deformity is to one side, and on the side corresponding to the curvature, and therefore usually in the right dorsal or

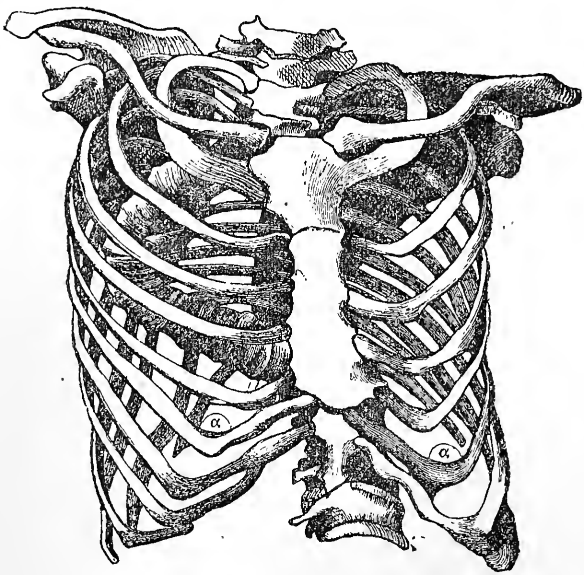


FIG. 25.—Thorax from a case of scoliosis. (Henke.)

left lumbar regions, as this is the most common form of idiopathic scoliosis. On the concave side, the posterior parts of the rib-arches and angles are depressed, causing a flattening of the posterior thoracic wall, whereas, in front, the costal cartilages form a projection, while on the convex side there is a corresponding flattening. It will thus be observed that there is a projection and a flattening on *both* sides, a *posterior projection* and an *anterior flattening* on

the convex side of the groove, and *vice versa* on the concave.

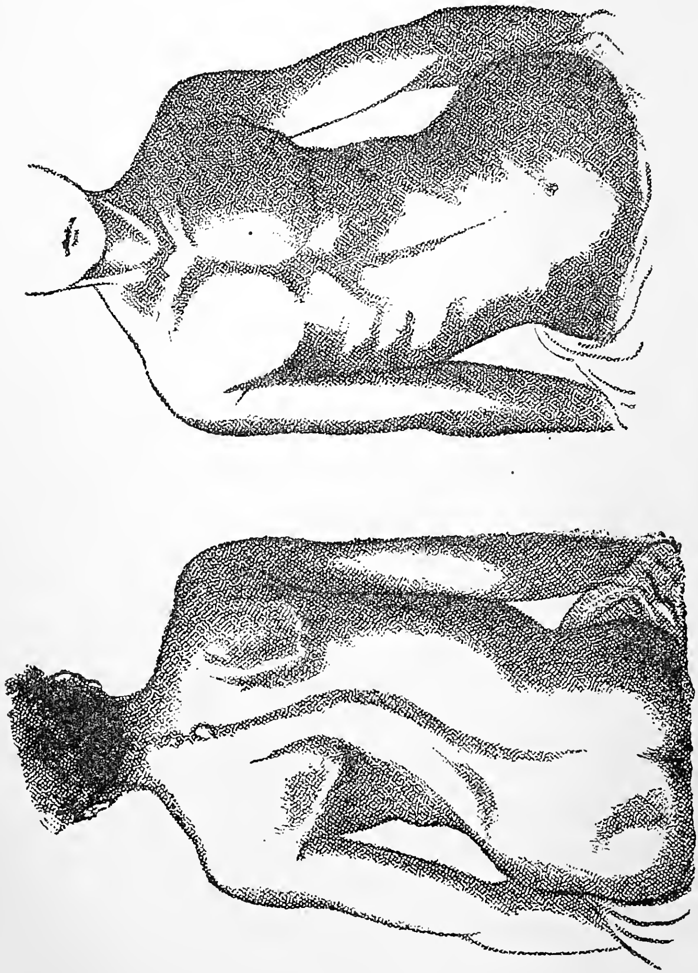
The *sternum* is sometimes convex in front and at other times concave, and the xyphoid cartilage may be depressed or the reverse. At other times it may incline to one side or the other, or be obliquely placed. The alterations of the sternum are dependant upon the diminished length of the thorax. The interior of the thoracic cavity becomes considerably altered in shape and size, as is well shown by transverse sections which clearly display the groove formed, in severe cases, behind the spine on the convex side of the curve. This is due to the backward displacement of the ribs and the alteration of the costal angles on the affected side, and if the case be a very bad one, the ribs will be found in contact with the vertebral bodies, and this groove will be absent. The pleural cavities will also be altered in size and shape, being much contracted on the side corresponding to the deformity; this is due to the anterior flattening of the costal arches on the side corresponding to the curvature, and to the greater obliquity of the ribs from before backwards and downwards on the affected side. On the concave side the pleural cavity is enlarged to the extent of the degree of the spinal concavity, and of the anterior bulging of the ribs and cartilages; but this enlargement is to a great extent counteracted by the dimensions of the cavity in other directions, and especially, perhaps, by the posterior flattening of the costal arches.

Thoracic Viscera.—As would naturally be expected, these bony changes interfere with the contained viscera; and the *lungs*, as occupying the largest portion of the space, and in consequence of their consistence, suffer the greatest alteration in shape and in function, and next to these comes the heart. Both lungs are diminished in size, though the greater change is found in that

occupying the convex side, so that in most cases the right lung is the smaller. If compressed in all directions between the spine and ribs, its posterior border becomes thin and flattened in the retro-spinal groove already spoken of, and the left one is flattened posteriorly, corresponding to the shape of the ribs on the concave side. The changes in the diaphragm, presently to be described, also cause changes in the shape of the lungs, so that in cases of great deformity, pathological changes must and do occur in the lung structure and function, causing hyperæmia, consolidation, emphysema, &c. The *trachea* and *bronchi* are altered in direction and size, and the bronchus corresponds in condition to that of the lung to which it goes, and similar and corresponding changes are found in the pulmonary arches.

In consequence of the change in position of the diaphragm, the *heart* is generally displaced upwards and to the left, though in the majority of cases it has not much deviated from its normal position. In severe cases of left lateral curvature, the space for the heart is diminished, so that it is hampered in its action; but in such cases, especially in later stages, the heart rests in the concavity of the groove. The size of this organ may be normal, or it may be hypertrophied, and in cases where the lungs are much interfered with, secondary changes, amounting in some cases to marked incompetence, will result, and these will react upon the lungs producing severe dyspnœa, palpitation and other alarming symptoms. The *aortic arch* is shorter than natural and corresponds to the spinal curve, and in severe cases there is a fold on it on the concave side, and a dilatation on the convex; and in bad cases of left lateral curvature the arch and a large part of the aorta may be found entirely on the right side. The vessels springing from the heart undergo corresponding changes. The venæ cavæ are found enlarged, the inferior may have undergone displacement correspond-

ing to that of the aorta, and in severe cases will be found quite away from the spine. It will be readily understood from these changes in the heart and enlarged vessels, that



Figs. 26 and 27.—Front and back views of a severe case of dorso-lumbar lateral curvature in a lad of nineteen.

a languid circulation, cold extremities, and visceral or peripheral congestion, are not very uncommon phenomena.

The *œsophagus* corresponds in curvature to that of the

spine in ordinary cases, but in severe cases it leaves the spine altogether, and passes straight down to the stomach. It is well that this is the case, and it explains the absence of dysphagia in severe cases of the disease.

Abdominal Viscera.—The *diaphragm* is pushed up through the displacement of the abdominal viscera, and through the alteration and position of its costal and sternal attachments, its foramina are altered in shape, size, and position, but usually not sufficiently to interfere with the transmitted organs.

The abdominal cavity is contracted in its dimensions, so that the viscera cause the anterior abdominal wall to project and also push up the diaphragm, but the *stomach* and *intestines* are usually displaced downwards, and the *liver*, which may be diminished or congested through interference with its circulation, is altered in shape at its lower and back part on the deformed side. The *spleen*, if not displaced downwards, is usually smaller than natural; the *kidneys* lose their normal level, following the rule of the other solid abdominal viscera in cases where the abdominal portion of the spine is much deviated. The kidney on the convex side of the curve is usually smaller than that on the concave, which undergoes a compensatory hypertrophy. The *abdominal aorta* also in similar cases will undergo corresponding deviations in form and relations.

The *pelvis* and contained viscera become affected in severe or in long standing cases, and in such the lumbar curvature will extend to the sacrum and coccyx, and the vertebral segments composing them will have undergone corresponding changes, being more developed on the convex than on the concave side. There will also be corresponding changes in the pelvic diameters, pelvic obliquity will exist, and a rotation from behind forwards and downwards, so that the anterior superior spines will be found on different levels from above

downwards, and from before backwards. The pelvic inlet will be diminished, *i.e.*, the antero-posterior diameter at the true pelvic brim will be lessened, and this change will be greater on the convex side of the curve. Such changes may be found in cases of severe lumbar curvature, whether this be primary or secondary. Though, as already stated, in some bad cases there is a marked alteration of the pelvic inclination, it is the exception, and the rule is, that the alteration in position of the ilia and the hip projection are apparent rather than real. These pelvic changes in females are of great practical importance, as they may cause difficult labours.

The *spinal cord*, occupying as it does the larger part of the canal, *i.e.* on the concave side, does not become compressed, and the contraction of the intervertebral foramina does not proceed to the compression of the nerves sufficiently to obliterate their avenues, though it may cause symptoms of irritation, neuralgia, cramps, &c.

The *spinal muscles* become secondarily affected. They are relaxed on the concave side, and stretched on the opposite. In both cases, from inactivity, they become fattily degenerated, though it is only in extreme cases that they are incapable of producing a fair amount of motion.

The Pelvic Viscera may, and especially in females do suffer through the bony deformity. I have known uterine displacements and rectal and bladder troubles to be directly due to these conditions, and it is hardly necessary to state that unless something can be done to improve the position of the spine, the treatment of such cases is anything but satisfactory.

Course and Prognosis.—These will depend upon the predisposing cause, and upon the state of the deformity when the patient is first seen; but often a good deal may be done if treatment be sought before the final stages of fixity

of the deformity have commenced, or proceeded to any extent. Cases of lateral curvature differ in severity, some, even without treatment, never passing beyond the stage of slight deformity, while others rapidly go on to extreme distortion. The prognosis involves, *first* the curability of the deformity; *secondly*, the consideration of any changes it may have produced upon the viscera. In ordinary cases, which are fortunately the majority, there is no great difficulty in affording relief to the deformity as well as to the

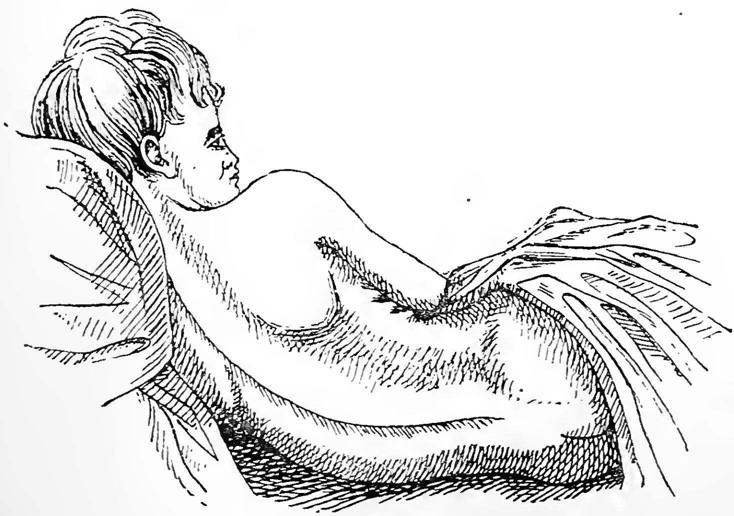


FIG. 28.—To show how a curve can be produced, or how an existing one can be corrected by lateral decubitus and the use of pillows.

pain and inconvenience it sometimes produces; but in the more extreme cases, where the deformity is very pronounced, the viscera, as already stated, are seriously interfered with, and the prognosis is necessarily more serious, and especially if the deformity be in the thoracic portion of the spine, as it often is.

If the subject be young, and there be but a single curvature, one may, with appropriate treatment, be sanguine of

cure; but if a secondary curve be established, the correction of the deformity is anything but easy, and if the case have proceeded to any considerable rotation of the vertebræ the result, as regards correction of the deformity, according to past methods of treatment, is usually not a good one. But I have seen enough to be able to say that appropriate gymnastic and hygienic methods, combined with proper supports between whiles, may do much good even in these cases. With properly constructed instruments, severe lateral curvature of the column may be to some extent corrected, but the rotation little, if at all, affected.

Treatment.—This may be divided into *prophylactic* and *therapeutic;* in the former our aim should be to instruct parents and the public generally, and especially the heads of schools, on the importance of providing properly constructed writing desks and stools, and also on the value of well devised gymnastic exercises, especially in the case of young girls. I feel sure we should see less of lateral curvature in the upper and lower classes were the evil consequences of bad habits of position, whether in standing or sitting, made known to the pupils and to their friends. The *prophylaxis* of lateral curvature has been given in the introductory chapter.

The second division of the subject, viz., surgical treatment proper, involves the consideration of *gymnastic exercises*, *massage*, *electricity*, *the use of various appliances*, and the necessity of *rest* where this is clearly indicated. Of course it must be understood that each case must be treated on its merits, and this is a matter of no great difficulty to the experienced; but for the guidance of practitioners I will concisely lay down a few rules applicable to the majority of cases. First, then, as regards rest.

Rest.—Should there be much pain, patients must be made to rest in the dorsal position, and when this becomes irk-

some, they may lie in the prone position, and the couch or bed should be covered with a firm, somewhat hard mattress, and it is well to put two blocks underneath the legs of the bed near the head so as to bring the body into an inclined position. Much may be done by the assumption of a suitable position in bed, or while resting on a couch during the day, and the illustration Fig. 28 sufficiently explains this.

The couch recently recommended by Mr. Lund, of Manchester, in the British Medical Journal, appears to be very serviceable. If the patients be quite young, it may be necessary to pass a broad bandage over the chest

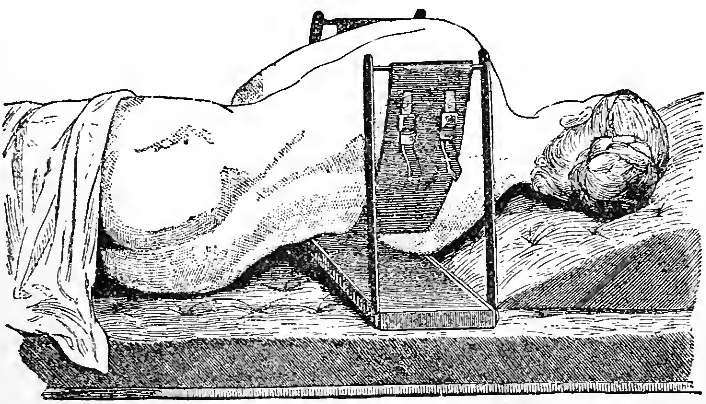


FIG. 29.—Apparatus for extension and counter-extension in lateral curvature by the body weight during recumbency.

and fasten it down to the sides of the couch or bed, but, occasionally, for a quarter or half an hour at a time during the day, they may be allowed to sit up, their backs well propped with pillows or by a bed rest; older patients should be allowed to have nine or ten hours sleep and to rest occasionally during the day. When the dorsal or prone decubitus is ordered, a board a little longer and broader than the patient should be placed underneath the

mattress, but the lateral decubitus is very serviceable in not a few cases of scoliosis, and Wolff has devised a suspensory cradle which I can strongly recommend and which is shown in the accompanying engraving. After a time the patients get used to it, and I have found that it not only relieves pain, when present, but is a valuable aid in the correction of the deformity during the day or night. The figure teaches how this simple apparatus should be used. As cases of right dorsal lateral curvature are the commonest, it is this portion that is represented as being extended by the swing or cradle. Though simple, this apparatus acts beneficially by correcting the lumbar curve through the natural weight of the parts between the buttocks and thorax band; by pressing on the dorsal curve and on the deformed chest, and thus forcing the other half of the chest to increased respiratory efforts, allowing of respiratory gymnastics while resting.

Gymnastics.—This part of the treatment, so essential in suitable cases, may be divided into *active* and *passive.* In the former, the patients have to execute the exercises themselves; in the latter, they are done by a properly trained assistant. As there are various methods, it will be out of place here to enter at length into them, and at present I shall content myself with pointing out those means and exercises which experience has taught me to be of great service. I shall reserve a fuller description for a separate publication.

Orthopædic gymnastics may be carried out with or without the use of apparatus, and though I have found that the simpler forms of apparatus effect considerable benefit in suitable cases, still I think there are other cases which are benefited by exercises with apparatus. Among the latter I would lay some stress on *auto-suspension, i.e.*, hanging by the arms from a parallel bar by which means the

body-weight extends the spine. This exercise may be repeated by patients strong enough to bear it two or three times daily, and an assistant may steadily pull at the legs, or a weight may be attached to them. The patient while taking this exercise should not allow the arms to be completely extended, and when sufficiently expert, should flex and extend the elbows so as to raise and depress the chin alternately above, and below, the trapeze or horizontal bar.

Going hand over hand up and down a ladder is an excellent exercise, and sometimes the patient should go up and down with fully extended arms, and at others with flexed elbows, and this exercise may be done with the hands alternately, or simultaneously with the two, jumping, as it were, up and down. But this can only be done after a certain amount of practice. With the trapeze or the gymnastic rings, the patient may swing backwards and forwards, bringing the abdominal and pelvic muscles into play and thus serving to extend the spine. With the parallel bars, the patient may stand between them at their entrance and thus expand the chest, or he may raise and depress the body while standing between the bars.

Self-suspension may be usefully applied in appropriate cases by some modification of Sayre's apparatus or that of Beely, and it may be *cephalic* or *axillo-cephalic*, that is to say, the lifting apparatus may be fixed to the occiput and chin, or to these and to the axilla. In the former, the effect on the spine is naturally greater than in the latter, but less care and practice are requisite in the latter than in the former. It must be clearly understood that these exercises must be gradually increased, and never continued till muscular or articular pains be produced, or until the patient becomes fatigued. I may mention that the use of the couch of Pravaz is an excellent method of taking gymnastic exercises in the recumbent position. The couch

acts passively in the direction of pressure and extension, as do the so-called orthopædic beds, and the curves of the couch correspond to those of ordinary scoliosis. The patient lying upon her or his side, and slightly inclined to the dorsal decubitus, arranges herself so that the convexity of the dorsal curve is applied to the convexity of the couch, while the left arm, which of course corresponds to the convexity of the curve, works the apparatus. Pravaz's couch

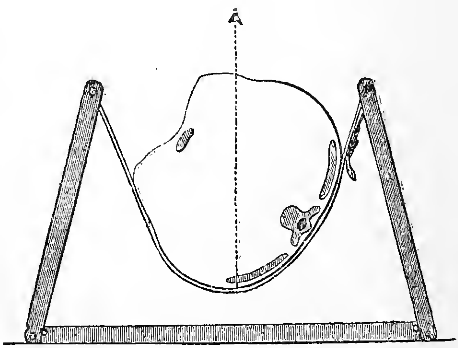


FIG. 30.—Diagram of the action of the lateral curvature cradle on the thorax.

was constructed to run on rails like a miniature tramway, but if the wheels be covered with rubber, they may be used in any room sufficiently large, and without the use of rails.

Swimming is also a good exercise in suitable weather, and in the metropolis it is quite easy for the patient to have tepid swimming baths, and should she be unable to swim, the exercise of learning is accompanied with interest and with benefit. Should for any reason water immersion be contra-indicated, *dry-swimming*, or swimming exercise in the air, is a good gymnastic means. The patient should rest the abdomen on a mattress or air cushion sufficiently high to allow flexion and extension of the knees, and the exercise should be practised in the ventral and dorsal posi-

tions for ten minutes two or three times a day. Jahn, of Germany; Ling, of Sweden, and others have devised systems of gymnastics which have become renowned, and though, in proper cases, there can be no doubt that rational gymnastics, selecting those exercises which anatomy and physiology combined with experience teach to be good, has been, and will continue to be, of the greatest service; still, unfortunately, and chiefly I think, through professional neglect of these valuable auxiliaries, the door has been opened to quackery, so that some have gone the length to pretend to cure cancer by these means. The exercises in these two methods, as well as in other variants, are numerous, though but a few are really necessary for our purposes. Some of them are carried on through the ordinary gymnastic machines, others by the hands of trained gymnasts, forming passive gymnastics, and others constitute mixed or double movements, combining active and passive gymnastics. Zander has, during the last few years, constructed most ingenious machines to replace the use of a trained gymnast; but excellent as these are, I cannot think, from what I have seen of them, that they can be in the majority of cases effective substitutes for an intelligent human guide.

The methods in these forms of gymnastics may be divided into the *voluntary* or *active*, the *passive*, and the *double* or *combined movements.* The first are executed by the patient, the second by the gymnast, and the combined, necessitate activity on the part of the gymnast and the patient. If the patient voluntarily execute a movement and be resisted by a gymnast, the exercise is termed *double concentric;* but if the gymnast make a movement which is resisted by the patient, this is termed the *double eccentric* exercise. The parent idea which gave birth to these forms of gymnastics was the *antagonistic* theory, already

explained, and often found wanting, and it was thought that these exercises would recover tone to the weakened and relaxed muscles; but it must be borne in mind that the views of orthopædists have varied as to which muscles are relaxed, whether those of the convex or the concave side. That those on the convex are hyper-extended, there can be little doubt, and also, I think, all will agree that this must affect their nutrition. That those on the concave side are affected with nutritive shortening and degeneration, has already been shown, but in this connection it must be recollected that excellent as these exercises are, they are only suitable to proper cases, viz.—those in the first stage, or those in the earlier degrees of the secondary stage. Of course, when there is little or no mobility in the spine, little or nothing can be expected from gymnastics; but it should be borne in mind that even if little can be done to correct the spinal deviation, as in the tertiary stages, still the exercises often benefit the general health, and so far are to be strongly recommended in suitable cases. Thinking, as I do, that many cases of statical scoliosis are due to altered and perverted vertebral pressure, with or without bone changes, such as softening, it might be thought that little could be gained from gymnastics; but this would be an error, as I have seen cases which, in the early stages at least, have derived marked benefit both as regards the curvature, and as concerns the general health.

Although the parent idea, as already pointed out, is false, the method is very useful, though the reason of its application is different. Ling and his pupils sought to re-establish muscular equilibrium by fortifying the relaxed muscles on the concave side by exercising them, and to effect this, he brought into play the muscles on the convex side, and thus sought to cure or benefit the curvature. Thus it will be seen that Swedish medical gymnastics or

kinesitherapie is really a form of local muscular exercise; and it would appear that the Frenchman Lachaise had conceived somewhat similar views antecedent to Ling.

Massage may be also either *active* or *passive*, and is but a branch of gymnastics, kinesitherapie or dynamo-therapeutics, and consists of shampooing, kneading, rubbing, frictions, or muscle-beating, combined with the use, if necessary, of various kinds of hot and cold douches. Its applications are numerous and valuable in suitable cases, but I must defer a fuller description for another time and place.

Electricity, judiciously employed, in its various forms, is of undoubted service in the treatment of lateral curvature. It may be applied in the interrupted or continued current, the latter having yielded me better results. One electrode should be applied in the mid-line over the spine, and the other to the muscles on the convex side of the curve, and also to the respiratory muscles. The ascending current, if the continuous form be used, seems to be preferable. Mr. De Watteville's work will be found to be a valuable guide in carrying out electrical treatment.

Mechanical Apparatus.—These may be divided into spinal *beds* and spinal *supports*. Orthopædic beds, whether mechanical, or by making the patient lie on inclined planes, are but little used now-a-days, and I think this is a pity, because there can be little doubt that in suitable cases a modification of these beds or couches is of service. The great price of the old couches was a serious drawback, but now-a-days an apparatus in which a patient may lie can be constructed at a moderate cost. These machines may combine the actions of pressure and extension, and such appear to be preferable. I need only mention a modern form of this apparatus, which is Hueter's modification of Bühring's apparatus.

The *sloping seat* recommended by Bouvier, and subsequently by Volkmann and Barwell, is useful in some cases, but its use must be combined with orthopædic gymnastics, massage, &c. If there be pes valgus and atonic genu valgum, a valgus sole plate and an instrument to gradually correct the knock-knee must be worn.

Spinal Supports and Corsets.—The object of these should, in my opinion, be to keep the spine in an amended or corrected position between the intervals of gymnastic exercises. Very numerous forms have been constructed, and it is not necessary to enter into these, especially as many are quite obsolete. The idea of them is to act with sufficient force in the right direction, so as to correct the flexion and rotation of the vertebræ, and, as the ensuing figures will show, they act upon the ribs, using these as levers to correct spinal flexion and torsion. It would, no doubt be better, if the pads were brought nearer the spine, so as to act more directly upon the vertebral column.

These instruments may be divided into various classes, such as those which act by extension only, through arm-crutches, taking the fixed point at the pelvis, and such are only suitable to mild cases; others which act through extension and lateral pressure; others which combine these movements; others which cause an inclination of the spine in an opposite direction to the deformity, and yet others which act on the principle of flexion. In cases where a support is really necessary, it is advisable to combine most of these movements, and herein arises the mechanical difficulty of making a light yet effective support; and when I use the term *support* I mean a *spinal corrector*. Before describing those which I have found the most serviceable, I will say a few words about the treatment of the second and third stages of scoliosis by means of elastic bandages; and I will at once state that I have never

ordered them, not believing, theoretically, in the power of the elastic bandages of Mr. Barwell to correct the deformity, for I have seen several cases that have worn them for years without the least benefit. I do not wish to state anything that will not bear the strictest analysis, and, therefore, I would at once remark that some of these cases would have been but little benefited by any form of apparatus, and therein consists my wonder that any effect could have been expected from the force, so comparatively slight, which these bandages exert. I think, however, that in incipient cases they may prove serviceable as spinal *reminders*, and thus educate the patient to keep the spine erect.

The following figure represents Hossard's apparatus applied to a right dorsal predominating curve, and its action is sufficiently obvious. It was fully described by Tavarnier in 1841, and almost all subsequent instruments have been constructed chiefly on its model. Eulenburg's instrument is a modification of this, but in practice it has been found that the rachet arrangement is difficult to fix so as to avoid pressure upon the spinous processes. I cannot help agreeing with Vogt that Hossard's instrument would tend rather to increase than to diminish the deformity, seeing, as the annexed figure will show, that there is no provision for correction of the vertebral torsion. That it will incline the spine there is no doubt, but that it will permanently correct the deformity is more than, from its mechanical construction, we can expect.

Guérin had an instrument constructed to act on the principle of contra-flexion. This apparatus is provided with an arm-crutch on one side only, and it seems to me on the wrong side, if the scoliosis be statical, and the predominating curve on the right. I think it will be obvious that a machine combining what experience teaches to be useful in these apparatuses, will recommend itself to prac-

titioners as serviceable, and I will presently describe such an one, but before doing so will say a few words concerning the plaister-of-paris jacket.

The Plaister Jacket.—It is not necessary to append illustrations of the various modes of applying Sayre's jacket. The methods of extension and of the use of

Fig. 31.—Hossard's spinal inclination corrector applied to a right upper dorsal curve.

the jacket are now well known, and are figured in his and other books on orthopædic surgery; but seeing that they have very largely fallen into desuetude, and, moreover, as at the meeting of the International Medical Congress in London in 1881, I showed the fallacy of this method of treatment in lateral curvature, I need not dwell further on it than to say that, in hospital practice, where expense

is an object, a modification of his plan will be of service in certain cases of scoliosis. In brief, the method is this : when the plaister bandages are applied, thick pads should fill in the concavity of the curve, and when the plaister is moist, holes corresponding to these should be cut out of the jacket. Of course the jacket should be applied to the patient in the extended position, and then be allowed to set. The pads can then be removed, and space is permitted for expansion of the chest and of the concavity of the curve. I only mention this as helpful in hospital and pauper practice, and I warn those using it, not to expect any permanent benefit in lateral curvature, though in slight and incipient cases, it is an inexpensive adjuvant not to be overlooked when combined with the other methods already described.*

The best form of the usual spinal supports is represented in the accompanying figure, and consists of a pelvic band, taking its fixed point on the iliac crest, and encircling the buttocks somewhat lower down ; to this band two crutches are fixed, and as these can be extended or lowered according to desire, extension is provided for. There are two uprights, each carrying a pad ; one for the dorsal region, which should be large and take a good grasp of the ribs and lower part of the scapula, and the other for counter-pressure in the lumbar region. These uprights permit antero-posterior and lateral motion, so that, as far as possible, lateral flexion and rotation is corrected. There

* The discussion at the recent meeting of the British Medical Association at Belfast, *à propos* of Dr. Sayre's paper, resulted very much in the repetition of the opinion I expressed at the discussion at the International Medical Congress of 1881, viz., that the jacket is useless in lateral curvature, but valuable in properly selected cases of Pott's disease. I failed to comply with the request of the Secretary of the Section to write out my speech, hence its non-appearance in the Transactions.

can be little doubt that in the first and second stages of the disease, these supports, combined with appropriate accessory treatment, are very beneficial, and in many cases curative; and when the deformity cannot be quite corrected, still they support the spine and relieve pain, so that it not infrequently happens that many patients object to leaving them off, and this I take to be a drawback. I wish it to

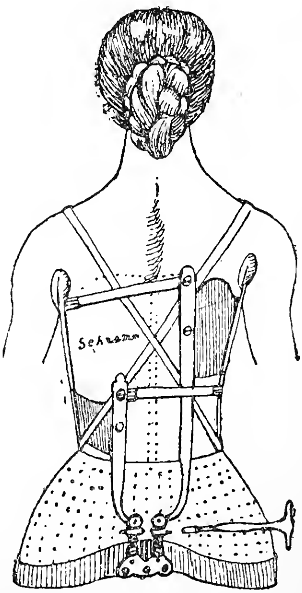


FIG. 32.—Support for right dorsal and left lumbar lateral curvatures. The key is shown on the right of the figure.

be clearly understood that I look upon spinal instruments only as valuable adjuncts; if they be trusted to alone, disappointment will be the result, and if the pads do not fit properly, injurious pressure may be the outcome. It must also be recollected that if only the support be worn without appropriate gymnastics, the muscles are not properly exercised, and the atrophy, which naturally occurs in scoliosis, will by their means be assisted to progress.

I have had constructed according to my directions, by Mr. Schramm, a light and effective machine which appears to combine movements in the various directions necessary to facilitate cure. If the scoliotic spine be sufficiently moveable, either before or after the use of gymnastics, &c., to permit of gradual correction, I know of no instrument better calculated to effect it; but again I would insist that even this, which I make bold to call a *perfection*, though not, perhaps, a perfect instrument, is only an indispensable accessory to the treatment.

The reader will thus perceive that I regard spinal supports as of undoubted importance as accessories; but to be of service, they must be applied with sound orthopædic knowledge and surgical discernment, and, moreover, they must be constructed on just mechanico-anatomical principles. Those instruments which act solely on the principle of extension are useless, those which act on the principle of uniform pressure, like Sayre's bandage, are worse than useless as a rule, because they can never unfold a curve, and according to my experience, and that of others, they even fail to maintain the extension of the spine which has been produced by the suspension apparatus, and, moreover, perseverance in their use loses valuable time. Inclination and flexion machines like those of Hossard and Guérin do not fulfil the indications. The former act on the principle which appears theoretically good, viz., to incline the trunk from the side to which it naturally tends in the disease, and by pressing on the greatest point of curvature, to force that part of the spine situated above it to become corrected; but experience proves that it is only of any value in the milder cases, and that if applied to well marked curves, the pelvic support shifts, and it is necessary to fix it by a perineal band which, at best, is irksome. The best instruments are those which combine extension and pressure in

the antero-posterior, lateral and oblique directions, but it must not be forgotten that if the scoliosis be due to rachitis either infantile or adolescentium, the ribs may be affected, and that pressure will only further deform the ribs without correcting the mal-placed spine.

Spinal Tenotomy or Myotomy.—Guérin first introduced this method, and claimed many successes, but it was found on examining the cases sometime subsequently, that they had relapsed, or rather, had been made worse by the operation. Sayre has divided the latissimus dorsi, and was satisfied with the result. My own view of these operations is that, as a rule, they are valueless and may be harmful, but that in rare exceptional cases, division of the contracted latissimus dorsi may be of service.

Forcible rectification under Anæsthesia.—I have, as yet, no personal experience of this plan, and should think that but few cases are suitable to it. However, it seems to me a plan worthy of trial, and when I get a case that appears to me a proper one, I shall, carefully, adopt it. Of course, in any proceeding of this kind, great caution would be necessary to avoid serious injury to the spinal column and its contents.

Summary of Treatment.—It will have been observed that I believe in the curability of lateral curvature in the early stage, and in its amelioration in more advanced degrees, and that I consider the best means to these desirable ends to be of an *eclectic* nature. No one form of treatment, whether mechanical, gymnastic, or other, is alone of avail in the majority of cases. Each case must be treated on its merits, with due consideration of its cause, the general condition of the patient, the stage of the deformity, the mobility of the spine in its affected part, and in young women the state of the uterine functions. There is no panacea for lateral curvature, and only a large

experience, combined with a knowledge of the pathology of the disease—so far as it goes—are the safest guides.

Rest, if there be pain or discomfort in the erect position; gymnastics, especially local; massage applied by the surgeon or by some one knowing the elements of anatomy and physiology; electricity in suitable cases; tonics, &c., as previously described, are each and all of undoubted benefit, but it is scarcely possible to indicate accurately the limits of these, and to point out which cases are suitable and which not. This must be left to experience, and speaking from an exceptionally large one in orthopædics, and having in mind cases—not a few—which have, to all external appearances, become cured, while the general health has coincidently improved, I have confidence in recommending the *combined mode* of treatment which I have described.

CHAPTER V.

DEFORMITIES OF THE THORAX.

Pigeon-breast.

THESE are generally secondary to disease of the spine, or to thoracic inflammation, or new growths, or due to rickets. A common form of chest distortion caused by rickets, though sometimes independent of it, is *pigeon-breast.*

Synonyms.—Latin, *Pectus carinatum seu gallinatum ;* German, *Hühner oder Kahnbrust.*

Varieties and Causes.—It may be *primary* or *secondary.* The former is due to bone-softening, through local or general rickets or mollities. The latter is *acquired* and caused by scoliosis, kyphosis, lordosis, paralysis of the intercostals (after whooping-cough for instance), and pleurisy. It may be *congenital* as a result of pulmonary atalectasis. Sometimes this condition is hereditary and none of the above causes give evidence of their existence.

Symptoms.—Objectively the ribs are flattened at the sides, the lower part of the stomach projects, and the lower costal cartilages are deformed. The transverse diameter of the chest is diminished, and its antero-posterior increased, at the deviated part. Subjectively the patient complains of shortness of breath, and, in the severe forms, of palpitation. As the patients reach mid-life, bronchitis and emphysema are common.

Pathogenesis.—Some cases seem to be due to general

debility and to atonicity, especially of the respiratory muscles, which not acting sufficiently in raising and everting the ribs, these become flattened, and then the cartilages bend, and the sternum projects.

In the rachitic cases the view of Sir W. Jenner is that now accepted, and this is that the glottic aperture is not large enough to permit of air entering with sufficient rapidity to occupy the increased space formed in the thorax by diaphragmatic action, and consequently the effects of atmospheric pressure are expressed on the chest-walls, the ribs are sharply bent at their angles, and the costal cartilages turn abruptly backwards at the costo-cartilaginous junctions, and the sternum projects forwards. In such cases there is a groove along the line of union of the ribs and cartilages, just behind the nodules or beads which are formed at these spots. The pressure of the arms on the sides of the chest also tends to produce *pigeon-breast* when the bones are soft.

Prognosis.—If the spinal deformity can be cured or improved, the thoracic change will ameliorate. Rachitic cases, especially if due to the acute or severe form of general rickets, are much less hopeful, but even these are not absolutely hopeless. The paralytic form is generally curable, and the cyphotic form is very amenable to treatment.

Treatment.—This must be directed to the cause, and if this can be satisfactorily acted on, much may be hoped. The rachitic cases require the treatment spoken of in the chapter on Rickets; the paralytic need massage, electricity, and respiratory exercises, and these are also very serviceable in those cases secondary to spinal curvature. In these latter cases, the curvature and its cause must be attacked, and local gymnastics combined with the other means just mentioned, are of great service.

CHAPTER VI.

DEFORMITIES OF THE ABDOMEN.

Pendulous Abdomen is a common and unsightly condition, especially in women, and may be due to *general* or *local causes.* Obesity is the commonest among the former, and among the latter are local polysarcia and umbilical and ventral herniæ.

Symptoms.—The objective symptoms are sufficiently obvious. The patient's complaints refer chiefly to weight and dragging from the size of the tumour, and if this be a rupture, the sensation is usually referred to the navel or the upper lumbar spine. There is usually difficulty in walking or standing, due to discomfort from the weight of the tumour, and shortness of breath, which is probably due to general corpulence.

Diagnosis.—Ascites, tumours of the abdominal wall, a much-enlarged liver, ovarian and abdominal tumours, pregnancy, and lordotic abdomen, may occasion difficulty to the inexperienced, but the real differential diagnosis lies between extra-abdominal tumour, umbilical or ventral hernia, and local polysarcia. The fact that in these the protuberance can generally be made out to be chiefly outside the abdominal wall, and that in local over-production of fat, distinct creases, often with eczema in the folds, are present, will assist, and with the history of the case will, in most cases, clear up the diagnosis.

Treatment.—In polysarcia local compression by means of a properly fitting belt is of service, combined with a correct diet and regimen for corpulence. In extra-abdominal tumours excision is the remedy, especially as these growths are generally innocent. There is risk, however, from peritonitis, as most of these growths are attached beneath the transversalis fascia, and sometimes they have to be separated from the peritoneum, as was the case in a large growth with a vascular capsule which I removed from a patient in the hospital for women. In hernia, unless there be symptoms calling for operative interference, the treatment should be directed to supporting the rupture and preventing further protrusion. When operation is neces-

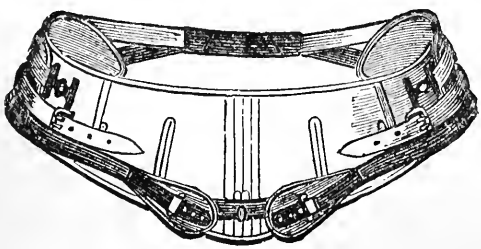
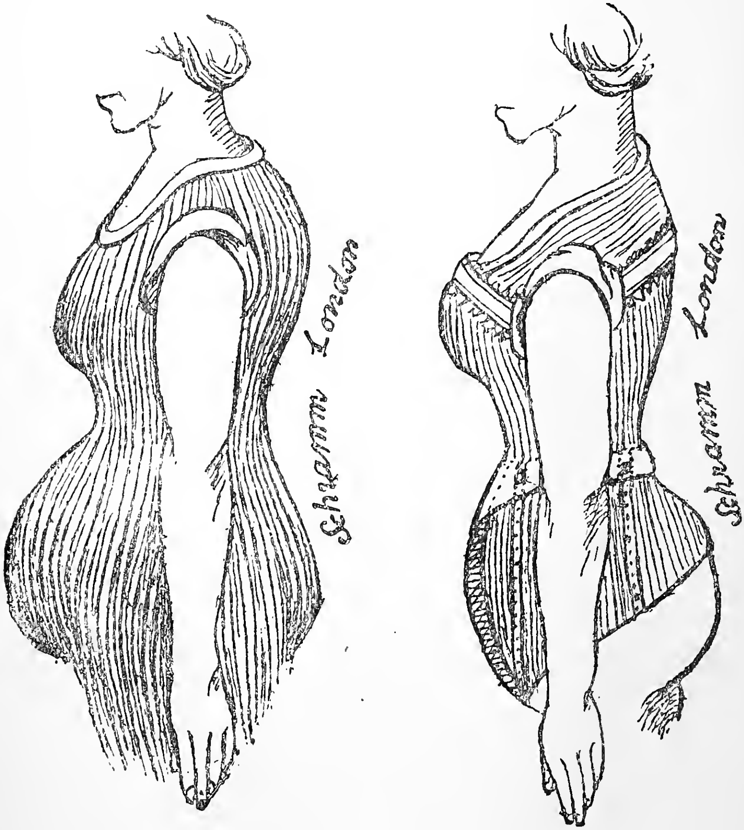


FIG. 33.—For pendulous abdomen.

sary, a free incision should be made carefully over the tumour, prolapsed omentum should be tied in pieces and removed, the bowel returned, and the peritoneal surfaces brought well together. It is well, in some cases, to remove a portion of the thinned and stretched skin, so as by the cicatrix—which should subsequently be well supported by a proper belt—to still further contract the abdominal cavity.

I operated on two umbilical and one ventral hernia (one male and two females) some years ago in this manner, and the patients and I were well pleased with the results. A middle-aged woman was under my care in Locock ward of

the Hospital for Women, sadly inconvenienced by an enormous hernia through the linea alba, which, on standing, reached nearly to her knees. I proposed, without specially urging, abdominal section, which, at one time, she seemed



FIGS. 34 and 35.—Protuberant and pendulous abdomen before and after application of a proper corset.

inclined to undergo, but subsequently an abdominal belt was constructed which enabled her to once more get about her domestic duties with comparative comfort.

CHAPTER VII.

TORTICOLLIS OR WRY-NECK.

Definitions.—Wry-neck is a deformity characterised by *lateral inclination* and *rotation* of the head. The simpler forms of torticollis are devoid of rotation, and are not usually described under this heading. I take up this subject after that of scoliosis, because the pathological conditions of flexion and rotation of the cervical spine, exist in well marked cases of this deformity, though they are usually produced by muscular action only.

Synonyms.—Latin, *Caput obstipum*, *Torticollis;* German, *Halsteifheit Schiefhals;* French, *Torticolis*, *Cou tortu.*

Varieties and Causes.—Wry-neck may be *congenital* or *acquired.* It may also be *acute* or *chronic*, the former is usually symptomatic of an inflammation of the cervical muscles or fascia which is either due to cold, rheumatism, inflammation, or injury; the latter may be caused by muscular spasm or contraction, or by paralysis; or it may be due to the condition of the bones, vertebral articulations, to burn-cicatrices, or to disease of the nervous system. Cervical tumours may also give rise to it, as may also caries of the cervical spine, and dislocations and fractures. This malady may be *permanent*, *intermittent*, *spasmodic*, *symptomatic*, or *essential;* and these terms sufficiently explain themselves. It may vary in degree, being

like other maladies, slight, moderate or extreme. It may be simulated by hysteria and by malingerers. It is occasionally hereditary. The *congenital* form may be due to nerve lesions or deformities, or to deformed vertebral articulations, or to intra-uterine malposition, or obstetric

FIG. 36.—Congenital muscular torticollis in a boy aged ten.

injuries. The *acquired* forms are usually due to the other causes stated in this paragraph.

Traumatic Torticollis may be due to partial or complete luxation of the cervical vertebræ, or to rupture of some of the cervical muscles, and sometimes, in infants, it

is congenital in the sense that the sterno-mastoid alone, or other cervical muscles are torn during birth, or compressed by the forceps, and paralysed. There is also a form of wry-neck in infants due to a tumour-thickening of the sterno-mastoid, the exact nature of which has not yet been made out. I have seen many examples of all forms, and not a few cases of wry-neck due to injury to the cervical spine or cervical muscles, have come under my notice at

FIG. 37.—Cicatricial torticollis following a burn.

the London Hospital. The ordinary forms of torticollis which come under the care of the Orthopædic Surgeon, are those due to lesions of the muscular or nervous systems; the former are the commoner; that is to say, whether the primary mischief be in the nervous system or in the muscles, some of the latter are always found contracted when the cases come under care, and are corrected by tenotomy, an appropriate apparatus and gymnastics. The sterno-mastoid appears to be the chief muscle in the production

of the deformity, but others may also be affected, so that any, or all of the muscles which produce flexion and rotation of the head may give rise to it. I have seen cases due chiefly to the action of the trapezius, the splenius, the scalenes and other muscles, and in such cases the deviation of the head is different; and Duchenne has described a case in which the deformity was due to the combined action

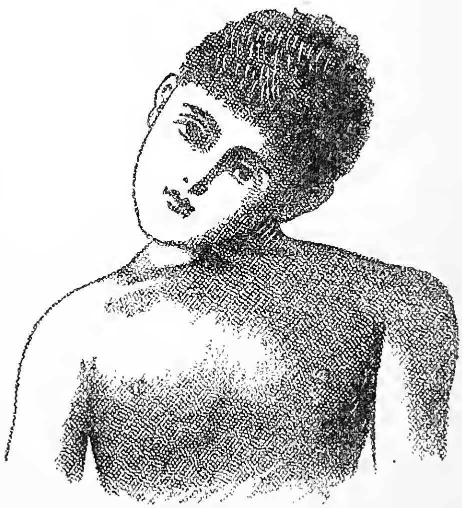


FIG. 38.—Spastic muscular torticollis in a girl aged ten.

of the splenius and anterior scalene. Typical torticollis is, however, caused by the action of the sterno-mastoid.

Torticollis due to contraction or shortening of the sterno-mastoid.—It will be well briefly to consider the action of this muscle. Some anatomists regard each sterno-mastoid as composed of two and even more muscles, but all agree that in contracting, it inclines the head to its own side, and causes it to rotate so that the face is directed to the opposite side; this is when it takes its fixed point below, but if the fixed point be at the mastoid process, it

acts as an inspiratory muscle. It is supplied by the spinal accessory nerve and cervical plexus, and Sir Charles Bell considered its cervical nerves as making it a muscle of relation, while the spinal accessory caused it to contract in an involuntary manner during respiration. Claude Bernard considered that the spinal accessory had nothing to do with simple respiration, but was only brought into play during respiratory efforts, as in ordinary singing or in dyspnœa. Haller thought that the sternal portion of the muscle produced cranial rotation, and that the clavicular part caused depression towards the corresponding shoulder. J. Guérin considered that the sternal part was rather a mover of the head than a respiratory muscle, and that the clavicular part was essentially inspiratory. Modern Anatomists are pretty well agreed as to its actions of flexion and rotation of the head, and I think there can be little doubt as to its being, at any rate, an extraordinary muscle of inspiration; but of this there can be no question that contraction, retraction, or paralysis of one sterno-mastoid, from whatever cause, will induce wry-neck.

It may be well to define these terms. By *contraction* is meant that condition of a muscle in which it is largely beyond voluntary control, and the fibres of which are in a permanent state of shortening, without, however, showing microscopic changes. This state ceases under anæsthesia, and it appears that it is due primarily to some altered condition of the nervous system, but if contraction be sufficiently prolonged, it must pass into retraction. *Retraction* results from a muscle being constantly involuntarily shortened, and a portion of such muscle shows, microscopically, atrophy and fatty-degeneration. It persists during anæsthesia, unless the degenerated muscle be torn, and may be the result of nerve lesion or of injury or inflammation of the muscle itself or its sheath. If a muscle be

paralysed, it may not only undergo fatty degeneration, but its opponents may, and often do in time, contract, and its two ends becoming approximated will gradually lead to retraction, so that in paralytic torticollis there may at first be clonic spasms of the opposite sterno-mastoid leading finally to its contraction and retraction.

FIG. 39.—Posterior view of a case of muscular torticollis, showing the curve of the cervical spine and the altered levels of the shoulders and scapulæ.

Wry-neck is almost twice as common on the right as on the left side, and is, in my experience, commoner in females than males. The congenital forms are rare and may be temporary, intermittent, or permanent, of which the latter is, if I may use the expression in these rare cases, the commonest, and the symptoms of this, and the acquired forms, are very similar, except that in infants with fat, short necks, the prominence of the lower part of the sterno-mastoid is not so evident.

Spasmodic or Intermittent Torticollis.—In this condition the head is not involuntarily and immovably fixed in one position, but the patient, in some cases, has the power of correcting the deformity, while in other cases the spasm is chronic and interrupted, and the symptom appears due to neurotic local convulsions. Other cases are considered by Duchenne and some nerve pathologists to be due to functional spasm, and such instances are characterised by continuous and painful or indolent contraction, or by chronic contraction and tremors, especially if the muscles be voluntarily brought into play; in fact, they are similar to functional spasms in other regions, a familiar instance of which is stuttering, which, as is well known, is aggravated by volition and mental excitement. The nature of the lesion, which is probably in the nervous centres, has not yet been determined. In these cases the wry-neck is apparent when the patient is standing, but disappears on lying down. Duchenne relates the case of a man at sixty whose sterno-mastoids, while standing or sitting, contracted strongly, and forcibly flexed his chin against his chest, but when he threw his head back, the contractions at once ceased, and returned directly he attempted to bring it forward. Not long since I treated a case at the London Hospital which was under the care of Dr. Jackson. He was a man of middle age with convulsive postero-lateral *jactitation*, as I called it, *i.e.*, his head was thrown chiefly backwards and sometimes with rotation to one or the other side, and this condition largely disappeared when he was lying down or when asleep, but on standing it returned, and especially when attention was drawn to him. It was not a question of malingering, and I first stretched, and then excised a portion of each spinal accessory nerve, with, however, only temporary benefit, as the disease was probably high up in the cord. We once thought of dissecting out and stretch-

ing the cords of the brachial plexus, but on reconsideration, this idea was abandoned. I believe that the convulsive attacks returned, though, perhaps, in not so severe a degree. There is a form of *rotatory* torticollis in which the head executes a series of movements of lateral flexion and rotation, and sometimes these are regular and continuous, but more commonly they are spasmodic, though often rhythmical. This is a chronic affection and difficult of treatment. Its cause seems to reside in the nerve centres, and the sterno-mastoid alone, or associated with the trapezius and splenius, are commonly the muscles affected.

Paralytic Wry-neck.—This may be due to a central nerve lesion, or to mischief or injury in the course of the nerves supplying the cervical muscles. If one sterno-mastoid be paralysed, the other contracts and produces the deformity, and the secondary changes due to approximation of its attachments result, so that it is often necessary to divide both heads of the contracted muscle before the deformity can be reduced. In infants it has been produced by obstetric injury or manipulation.

Wry-neck produced by other cervical muscles.—When the clavicular portion of the trapezius assists the sterno-mastoid in producing the deformity, its anterior border is prominent, and the head is more inclined to one side and thrown somewhat backwards. If it be recollected that the external branch of the spinal accessory supplies both muscles (at any rate in part) their conjunction in producing many cases of this deformity is only what one would expect. Sometimes the levator anguli scapulæ, the splenius and anterior scalenes may singly, or together, act in concert with the sterno-mastoid of the opposite side, and we may thus get various positions of the head, which, in the case of the splenius or scalenes of one side acting with the sterno-mastoid of the opposite, would cause extension and

extreme rotation of the cervical spine, whereas the levator of one side acting with the sterno-mastoid of the opposite, would cause increased lateral flexion and rotation.

Gooch relates a case of wry-neck due to contraction of one platysma, and in this case the corresponding labial commissure was much depressed. Dieffenbach records an

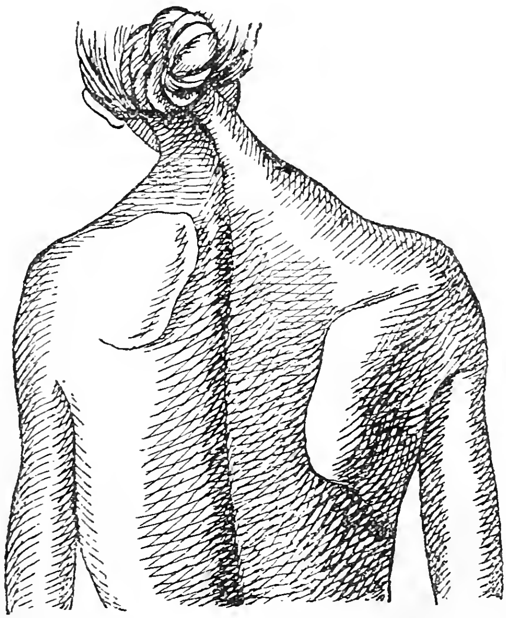


Fig. 40.—Wry-neck from nervous diseases in a girl aged twelve. There was spastic contraction of the sterno-mastoid and deeper cervical muscles, and a paralytic wasting of the muscles of the left side. The left scapula was less developed and much more drawn up than the right. When an infant she had infantile paralysis.

instance in which both these muscles were contracted, the head being directly drawn downwards. If only a part of this muscle be contracted, the position of the head will vary according to the part of the muscle affected. When the platysma is much contracted, the grooves in the skin are strongly pronounced.

Age, sex, and side of the disease.—In my experience, which I believe agrees with that of most orthopædic surgeons, this affection is commonest in young people. I have also met with it more frequently in females, and the majority of my cases have been on the right side. Sometimes the head is inclined towards the shoulder of the same side on which the muscle is contracted, and the face is turned to the opposite side. The amount of inclination and rotation will vary according to the extent of the deformity. In the severe cases the shoulder and ear may touch, the skin will be puckered on the concave side, and tense on the convex. The chin will be turned towards the shoulder opposite to the muscle producing the deformity, which latter will be found prominent and tense, according to the degree of contraction or retraction which has occurred. It is generally smaller because of the fibrous degeneration which it has undergone.

Symptoms.—These have been partly given in the preceding paragraphs. The deformity is obvious. The contracted muscle is not usually painful when at rest, though it may become so when the deformity is attempted to be corrected by the surgeon's hands. Voluntary motion to rectify the deformity is entirely, or almost completely abolished, though the patient can often increase the deformity. In many cases passive movements, without anæsthetics, produce little effect, though the tension and prominence of the muscle may be thereby increased. The temperature on the contracted side is slightly higher than that of the opposite side. In cases of long standing, the cervical spine becomes affected so that the spinous processes of the upper and middle cervical vertebræ form a curve, the convexity of which is usually, in my experience, on the opposite side to the deformity, though sometimes it may be on the same side, and if the case be an old one

or congenital, and has lasted for some time, secondary curves are formed in the dorsal and lumbar regions, and the concavity of these curves will be in an opposite direction to that of the curve immediately above.

In old-standing cases, the face and head on the side affected are deficiently developed, the angle of the mouth and the eye on the side affected, are drawn down, so that in some cases double vision results, the opposite cheek appears stretched and that side of the face more prominent. In severer cases the functions of the larynx are interfered with, the side of the head corresponding to the deformity is more or less atrophied, while the opposite appears, in consequence, larger than normal; and it has been shown that this condition is associated with a defective development of the corresponding cerebral hemisphere, causing a relative inferiority of the muscles of the opposite side. Bouvier found in a *post-mortem* which he made, that the carotid on the deformed side, was much smaller than that on the opposite; and this, he thought, accounted for these abnormalities of development.

Pathology.—But little is known of the *primary* conditions leading to the deformity, except that there is some source of irritation, and possibly a sclerosis about the seat of origin, or in the course of the fibres of the nerves supplying the cervical muscles, but the *secondary changes* produced by the deformity have been ascertained in a very few cases. In these the muscles have been found degenerated, the ligaments shortened on the affected side, the vertebræ compressed on the same side, and the articulations partially or completely destroyed. But in other cases of several years' standing, only a slight diminution of the height of the vertebræ, and corresponding vertebral substances was observed.

With reference to the question whether one or both

origins of the sterno-mastoid are implicated in the disease, there seems to be no hard and fast rule, though I have generally found that if the sternal portion, which is almost always involved, has been divided, the clavicular becomes prominent; so that if at the origin of the malady, the sternal portion is first affected, later on the clavicular part becomes implicated by the position assumed. I would say that in rather more than half of the cases when first seen, both portions are affected; and that of the remaining half, the sternal portion is contracted three or four times more frequently than the clavicular portion.

Diagnosis.—Wry-neck due to nervo-muscular contraction is usually easy to diagnose from those cases of torticollis due to mal-position, or to cervical inflammation, whether of the bones, articulations or fascia, and from wry-neck due to the presence of a tumour; but the differential diagnosis between a purely sterno-mastoid torticollis, and one in which other muscles are concerned, is not so easy. If the position of the head and of the neck, the prominence and rigidity of the various muscles, and the actions they normally produce, be all taken into consideration, one may arrive at a pretty accurate estimate of the muscles involved. The action of the sterno-mastoid has been sufficiently spoken of, but it should be recollected that the upper part of the trapezius acting from below, inclines the head to its own side, while it slightly extends it, and turns the face to the opposite side. The anterior and posterior scalenes, acting from below, flex the neck and incline the head to the same side. The splenius extends the head, inclines it to its own side, and causes it to rotate the face towards its own side. The complexus extends the head and turns it to the opposite side; the levator scapulæ, acting from above, inclines the head backwards and to its own side. The platysma also

turns the head to its own side; so that *three* muscles in whole or part, turn the head to the opposite side, viz., the sterno-mastoid, the trapezius, and the complexus, whereas *five* draw the head towards their own side, viz., the scalenes, the splenius, the levator anguli scapulæ and the platysma. Paralytic cases in which the opposite muscle is contracted and retracted will only offer difficulty until a clear history be obtained. In these cases the patient cannot move the head in the least, nor produce any prominence of the muscles on the paralyzed side, and the surgeon can easily correct the deformity, meeting usually with next to no resistance; but if the case be of long standing, the opposite muscles will have become strongly retracted, and will offer obstacles to manipulation. In these cases, as in others, anæsthesia will clear up the question as to whether the muscle be simply contracted, or retracted, as in the former case the deformity can be rectified, whereas in the latter it can only be reduced by rupturing the muscle. The hysterical and malingering forms of the disease are best diagnosed under an anæsthetic.

Prognosis.—Although this deformity, whatever may be its cause, almost never leads to death, still it may, as already pointed out, occasion serious disabilities, and so interfere with the important movements of the head, and of the functions of the organs therein placed, that life is scarcely bearable. But fortunately the permanent, as contra-distinguished from the spasmodic forms, are amenable to surgical treatment, and not only may the deformity be rectified but the patient return to health in a happy frame of mind.

Treatment.—This must naturally depend upon the cause producing the deformity. If it be due to cold, injury, or rheumatism, appropriate remedies must be applied; if due to a syphilitic or gouty myositis the treat-

ment for these affections must be instituted. In the case of paralysis, *frictions*, *massage*, *electricity* by the interrupted or continuous current, nux vomica and strychnine may all be judiciously employed, and if these means fail, a well padded collar or head-supporter must be worn. If the opposite muscle be retracted, its tendon must be divided, and the subsequent treatment must be that of other forms of torticollis about to be described. In recent years, subcutaneous injections of atropine over the muscle, and the ether-spray along its course, have been recommended, though I know of no cases in which they have sufficed for cure.

In cases where the muscles are contracted, or even retracted, rectification under anæsthesia, with immediate fixation of the head in an apparatus, may be tried; tenotomy, however, offers the best resource in the latter case, but in the former, massage, electricity, and education of the neck-muscles by passive and active exercises, and by wearing a properly adjusted collar, should always have fair trial. In the majority of *permanent* cases tenotomy becomes necessary, and in acquired cases there can be no question but that when the muscle is retracted, and the deformity pronounced, this is the proper course; but in congenital cases one should, as a rule, wait till the child is from one to two years old, so that the neck may become more developed, and the tendon and its relations be more clearly made out before tenotomy be done. As to whether one or both origins of the muscle should be divided at the same time, opinions have been divided, but one must be guided by the condition of the clavicular portion after the sternal part has been cut. According to my experience, and that of the majority of orthopædic surgeons, both tendons will have to be divided more frequently than not, especially in adolescents and adults.

Tenotomy.—The best place to divide the muscle is at its lower part, because at its upper it is more or less surrounded with nerve filaments, and is pierced at a varying distance by the spinal accessory, and if the patient be an infant, the nearer one can cut to the sternum or clavicle the safer will be the operation. Ordinarily speaking, this operation is devoid of risk, though at least one case, which occurred in the practice of Robert, the distinguished French surgeon, was followed by death, and it will readily be understood that if any of the cervical veins be punctured there is great risk of entry of air into them. I do not think there is any great danger of injuring large cervical vessels, but the external or anterior jugular veins are near by, and may be pricked, and if wounded they are opened near their termination in the subclavian, so that if air were to enter them there would be great danger, but usually the result would be only a clot which would become absorbed. Robert's case died of purulent infection after wounding of the external jugular. It is better to give an anæsthetic, one assistant fixing the shoulders, and depressing that towards which the head is inclined, another holds the head, endeavouring to correct the deformity so as to render the retracted muscle prominent, and at the same time to increase the distance between it and the carotid and internal jugular. It is better to divide the sternal and clavicular parts through separate punctures.

The question as to the safer mode of dividing the muscle has arisen, *i.e.*, whether it should be cut from before backwards, or *vice versâ.* I have always adopted the latter mode as the safer, for in the case of any jerk when cutting towards the main vessels, a serious accident might arise. The tenotome is passed on the flat behind the tendon to be cut, a little above the clavicle, its cutting edge is then turned towards the skin, and a careful sawing motion is imparted until

the tendon is felt to give way. The knife is withdrawn, a pad of oiled lint is placed upon the puncture, which is covered with strapping, and a bandage is put over all. In dividing the clavicular portions, some surgeons think it is better to cut from before backwards, as then there is less risk of wounding the external jugular; but I have never adopted this plan, and I have never known the external jugular to be wounded. When the tendons have been divided, the deformity will be much more easily reduced, but the head should be returned to its deformed position for three days, and then the wry-neck instrument, which must be got ready before the operation be undertaken, may be adjusted, and the deformity gradually rectified. *Frictions*, *massage*, and *manipulation* must also be used while the instrument is being worn, and the patient encouraged to exercise voluntary control over the muscle which has been sectionized. The time during which the apparatus must be worn will vary according to the cause, nature and degree of the deformity, and ranges from one to three or more months in severe cases.

The treatment of *spasmodic* wry-neck is anything but satisfactory. In the cases in which it appears of a neurotic, or reflex nature, the cause of these must be ascertained if possible, and worms, carious teeth and other such causes must of course be attended to. Quinine, iron and other tonics, with *gymnastics of the affected muscles*, may be of service; but various anti-spasmodics, electricity and other means have often proved unavailing, as also has tenotomy. I well recollect the late Mr. Campbell de Morgan's case of spasmodic torticollis which at last became permanent, and saw his operation of excision of a portion of about a quarter of an inch of the spinal accessory. This case was ultimately, practically cured. I have on five occasions either stretched or excised portions of this nerve either before or after tenotomy (at a subsequent sitting), but can-

not speak very favourably of the results of the operation, and I think the experience of most surgeons and neurologists will agree with mine, but as several cases have been benefited by it, I will say a few words as to the best mode of proceeding.

Division, stretching, &c., of spinal accessory.—If two horizontal lines, the upper passing outwards from the angle of the jaw, the lower from the upper border of the thyroid cartilage, be drawn, they will form, with the anterior and posterior border of the sterno-mastoid, a parallelogram. The spinal accessory forms a diagonal to this geometrical figure running from its upper angle to the lower and outer. An incision three to four inches long

FIG. 41.—Collar for wry-neck.

should be made close to the posterior border of the muscle, commencing a little above the upper horizontal line, and ending just below the lower, the transverse cervical nerve may be seen and should be gently displaced. The cervical fascia should be opened, and when the posterior border of the sterno-mastoid is seen, this should be lifted up and forwards, and usually there will be no difficulty in finding the nerve piercing it. Guérin has recommended myotomy

instead of tenotomy in cases of spasmodic and rotatory wry-neck, because in dividing the muscle, he thinks that at the same time one may divide many of the filaments supplying it, but it should be recollected that after union has taken place, experience has shown that the malady returns.

Instruments.—The accompanying figures will sufficiently explain the action of these. The collars are most suitable where a permanent support is necessary, as in cases of paralysis, but they have not sufficient control in cases due to muscular retraction. In these cases, the head supports, or Minerva's must be used. The latter to be serviceable must be capable of four kinds of movements, that is to say, of flexion, extension, lateral inclination, and rotation. The joint may be a ball and socket one, as in the

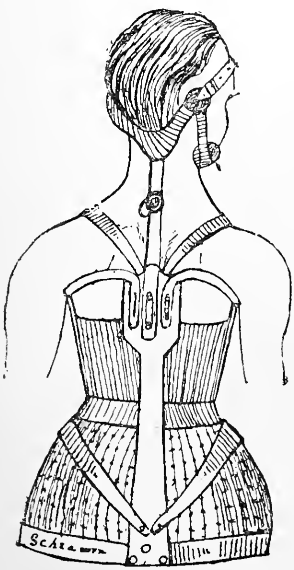


FIG. 42. — Instrument with ball and racket-joint for wry-neck.

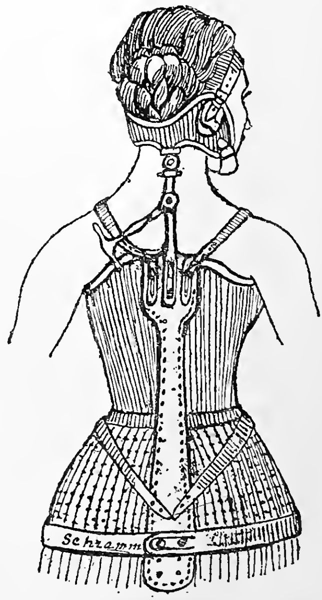


FIG. 43.—Instrument with key and racket-joint for wry-neck.

adjoining figure, and this instrument I have found very

useful, or it may be worked with a key as the next illustration shows. The fixed point is by means of a pelvic band, there are two arm crutches, and an upright along the spine to which the head-piece is attached. The head is fixed in the proper position between the cervical branches as shown; and two straps, one passing across the forehead, and another beneath the chin, keep the head in position. The instrument should always be worn at night, but it should be taken

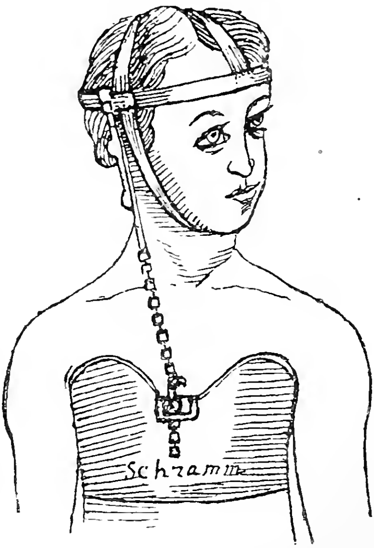


FIG. 44.—Apparatus for elastic control of affected muscle.

off for ten minutes night and morning, and the patient instructed to exercise the muscles on the diseased side. The collar may be substituted for night wear if the Minerva be irksome.

In milder cases, an apparatus for elastic extension is very serviceable, and is represented in the accompanying illustration.

OSSEOUS AND ARTICULAR TORTICOLLIS.

In the chapter on vertebral caries, cervical spondylitis is discussed, but here it will be well to devote a little space to the consideration, somewhat in detail, of the deformities secondary to bone and joint lesions of the cervical spine.

Muscular torticollis rarely produces osseous, *i.e.*, leads to anchylosis, though osseous and articular disease always produce contraction and retraction of the muscles.

Causes.—This disease may be due to (1) injuries of the spine, such as dislocations or fracture-dislocations; (2) to uni-lateral disease of the occipito-atloid or atlo-axoid joints; (3) to disease of the cervical intervertebral joints; (4) to caries or Pott's disease of the cervical bodies, and (5) to congenital deformity of the bones or joints. As regards the first set of causes, the orthopædic surgeon will have to be on the look-out for injury, as a cause, in the rare cases of torticollis due to such cause which present themselves at an orthopædic institution. The differential signs must be sought in general text-books. The second cause of the deformity is often due to tubercular or rheumatic disease, and the muscles of the side opposite to the bones diseased often become contracted. The joint disease may end in anchylosis, but oftener in destruction of the joint or joints, and suppuration with extension of the disease to the bodies and intervertebral substances may ensue, and a chronic torticollis then results, and is due to reflex contraction of several of the cervical muscles accommodative to the diseased articulation. This torticollis, when the diseased vertebræ have become anchylosed, is, of course, permanent and often extreme. The same remarks apply to the third cause, and the fourth is spoken of in the section on vertebral caries. With regard to the congenital deformity, suffi-

cient pathological material does not exist for a satisfactory explanation.

Symptoms.—It is here only necessary to consider the symptoms due to joint mischief in uni-lateral synovitis. The least rotation of the head causes great pain in the nape, radiating to the sides and front of the neck, and up the back of the head, which is kept fixed in one position, so that the patient turns bodily round to look at anything; while in muscular torticollis, rotation is permitted. Eating is peculiar, and carefully performed. Swallowing may be

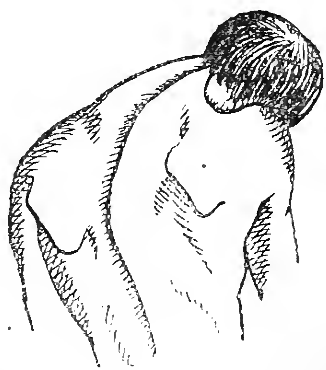


FIG. 45.—Extreme deformity, the result of cervical caries. Posterior view.

painful and difficult, owing to the formation of post pharyngeal abscess. The head is commonly supported by the hands. The cervical spines are irregular, and often there is swelling and pain at the back of the neck, and the sub-occipital groove may be more or less absent, but in thin people it is almost always present, while in fat ones it is naturally absent and is therefore useless as a diagnostic sign. In a late stage of the disease secondary dislocations gradually occur, and the resulting deformity is partly due to the direction and extent of the articular mischief, and partly to reflex muscular contractions. The displaced

vertebral bodies can be felt through the pharynx, and the projecting or irregular spines can be palpated posteriorly. In congenital deformity, and in some of the *acquired*, the head is flexed on the sternum, or is thrown backwards (cervical lordosis with bulging of bodies in the pharynx), and the head seems partly buried between the shoulders.

Diagnosis.—In osseous torticollis, the inclination and rotation of the head are on the same side, while in muscular, the inclination is on the same, and rotation on the opposite side. In articular torticollis these may vary, and are accommodative to the muscular contraction and to the extent of the articular disease.

Muscular *contraction* or *retraction* in muscular torticollis is permanent. In the osseous variety, the muscles only contract under certain conditions, as in the gradual change due to pathological, or communicated, or accidental movements, and the contraction usually affects most of the cervical muscles instead of the sterno-mastoid only.

The *pain* in spondylitis or arthritis is dull, and radiates to the neck and head; whereas in muscular disease it is in the muscle, and the least movement increases it.

Muscular tension is extreme in the muscular form, but usually much less in the osseous, and when the torticollis becomes fixed by anchylosis, the contraction is moderate, though a deep resistance, even under anæsthesia, may be felt.

Prognosis.—As regards deformity, this is almost always permanent, though its degree will vary according to whether the case have been seen early, and then properly treated. As regards life, there is great risk in disease of the first and second cervical vertebræ, and in occipito-atloid mischief, and cases of death from sudden dislocation, or suffocation from bursting of a retro-pharyngeal abscess into the larynx, from pyæmia or spinal meningitis, have been recorded.

Death may also result from extension of inflammatory mischief to the spinal or cranial cavities.

Treatment.—This will be given in the chapter on spinal caries, and consists mainly in absolute rest in the recumbent position, and firmly fixing the cervical spine, and counter-irritation in the early stages. Extension, as shown in the annexed illustration, is of great value if judiciously applied.

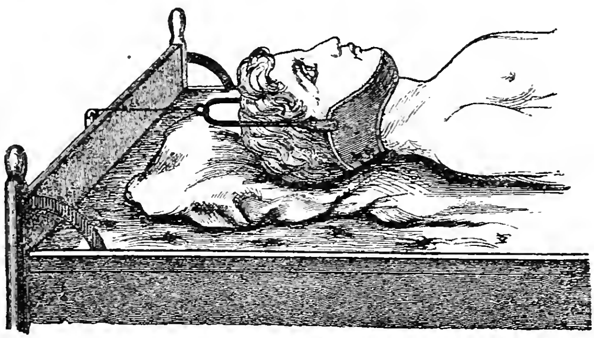


FIG. 46.—Apparatus for fixing and extending in cervical caries.

CHAPTER VIII.

CYPHOSIS.

Definition.—This is a symptom characterised by posterior curvature of part or whole of the spinal column. Most orthopædists and surgical writers have classed the posterior deformity resulting from carious vertebral bodies under this head, but it is better to treat this latter malady separately under the heading of vertebral or spinal caries, and to adhere to the accepted term of *angular* curvature to denote it. Cyphosis means round or bent-backed, and the deformity may be due to various causes.

Synonyms.—French, *Lordose;* German, *Spitzbuckel, Winkelförmige Knickung der Wirbelsäule, Rückverbiegung der Wirbelsäule;* English, *Spinal excurvation or posterior deformity.*

Varieties.—It may be *partial* or *complete*, and a good clinical classification is into *infantile*, *juvenile*, and *senile.* It may also be *essential* and *idiopathic* or *symptomatic.* The first variety is rare in infancy (always understanding that I am not speaking of cyphosis as the term has hitherto been used), and when found, is due to rickets or Pott's disease. Juvenile cyphosis, *i.e.*, when it occcurs in children or adolescents, is more common, and senile or *professional* cyphosis is commoner still, but essential cyphosis though more common than idiopathic lordosis, is far less common than scoliosis.

Causes and Seat.—Some writers, as Bouvier and Bouland, look upon scoliosis, cyphosis and lordosis as exaggerations of the normal spinal curves, and there is, in my opinion, not a little to favour this view, seeing that many cases of these deformities occur frequently in the regions where these curves physiologically exist; but there are many exceptions to the rule which yet require thorough elucidation. Partial cyphosis usually occurs in the dorsal region, and in the upper half or two thirds of it. In complete cyphosis there is a general curve from the seventh cervical to the last lumbar, and in some severe cases the cervical spine is also involved.

As is well known, at birth there are no curvatures, and this can be easily demonstrated by placing an infant on its back, which will be found in contact, in almost its whole extent, with the bed or table on which it has been placed, so that it is only at a later period, when the child has become accustomed to sit and stand, that the antero-posterior curvatures are developed. These are produced by muscular action so as to maintain equilibrium of the spinal axis, which the weight of the child's body tends constantly to displace. These antero-posterior curves become gradually formed, and increase as the child is able first, to hold its head erect, and secondly, to walk. We then get an anterior cervical curve, a posterior dorsal one, and the anterior lumbar convexity, and these three curvatures compensate each other, and tend to strengthen the column and protect it and its contents against shocks.

The Brothers Weber thought that in the neck and loins the curvature depended chiefly on the form of the intervertebral discs, and that in the dorsal region it was due to the more wedge-shaped formation of these vertebræ. Hirschfeld, on the contrary, asserts that he never found notable differences between the height of the anterior and

posterior surfaces of the vertebræ, and he attributes the production of these curves to the ligamenta flava. Coulomb attributes to the alternative diminution in front and behind of the intervertebral discs, the chief *rôle* in the production of these physiological curves, and considers that the persistence of these curves is due to the action of the ligamenta flava added to the retraction, gradually increasing, of the anterior and posterior ligaments, and also to the weight of the upper portion of the trunk and limbs. It would thus seem most probable that the production of idiopathic cyphosis and lordosis, is due to the repeated and non-compensated action of the causes just given, and these, if allowed to progress unchecked, lead to severe and permanent changes in the bones and articulations. The deformity may also be hereditary, or it may be due to mechanical causes acting on the spine affected with rachitis adolescentium; and the senile forms may be induced by gout or rheumatic arthritis.

Pathology.—Museum specimens, which are chiefly taken from well marked cases of long standing, show that the anterior parts of the discs and vertebral bodies are compressed; that the transverse processes are separated from each other, and that the laminæ are flattened and shortened, and in some cases the spinous processes are also further apart than natural. The vertebræ most commonly affected are the 5th, 6th, and 7th dorsal; next in frequency come the 3rd, 4th, 9th, and 10th, and last of all, are the 6th and 7th cervical. In some cases the intervertebral discs only measure in front half, or even less, of their usual height. The essential part of the malady consists in the diminution of the height of the spine in front, and the deformity is nothing but an exaggeration of the normal posterior dorsal curve. In severe cases, the diminution of the *bodies* amount to nearly a half of their natural height.

In cyphosis which has lasted a long time, or in the senile form of the malady, the intervertebral *discs* may have disappeared, and the bodies have became anchylosed either *centrally* or *peripherally*. In the former, the adjoining surfaces of the vertebral bodies become fused, and bony anchylosis between the laminæ, articular processes and the spinous processes occurs. In peripheral anchylosis it is the anterior common ligament which becomes ossified, so that these terms refer, the latter to the surrounding ligamentous structures with little involvement of the bone, whereas the former applies to primary changes in the bones and intervertebral discs.

This disease, which is commonest in the *dorsal* region, produces noteworthy changes in the thorax, the vertical and transverse diameters of which are diminished, while its antero-posterior diameter is usually increased, and these changes will, of course, vary according to the form and extent of the curve; so that a slight cyphosis affecting the dorsal region will produce little or no noteworthy deformity, whilst if the disease be partial and severe, the thoracic deformity is more marked. A transverse section of such a thorax would show it to be an ellipsoid larger in front than behind. The intercostal spaces are diminished, the ribs become more or less straightened, the upper ones being nearly perpendicular to the spine, the lower very oblique. The sternum is usually convex in front, but in extreme cases where the deformity is marked, it may, however, be depressed in its middle part.

Symptoms:—In Infantile Cyphosis, which is often rachitic, the most frequently observed symptom is a curvature in the dorso-lumbar region, while in Juvenile Cyphosis the dorsal region about its middle part is more commonly affected. The existence of these projections, and the fact that the subjects usually carry their heads forwards with

the chin approaching the sternum, the shoulders raised, and carried forwards, the posterior borders of the scapulæ standing out, so that the fingers can be passed between them and their corresponding ribs, are enough to indicate the nature of the deformity. Tamplin has drawn attention to the occurrence of sub-scapular crepitation in some of these cases, and this may probably be due, in rachitic cases to the scapula gliding over the beads on the ribs. A compensatory lumbar lordosis occurs in cases of long standing, and in such cases the patient's belly projects, and the walk of the subject is peculiar, in that the trunk is carried backward, so as to maintain equilibrium. Sometimes cyphosis and scoliosis co-exist.

Juvenile Cyphosis occurs most frequently about the age of puberty, and is more common in girls than boys. It may be due to a general laxity of the system, or of the spinal muscles and ligaments, or it may be due to a rachitis adolescentum aggravated by vicious attitudes. It may also be due to bad positions in writing and sewing at school.

Senile or professional cyphosis occurs, as the terms convey, in older subjects, and is induced by certain positions repeatedly assumed in one's vocation in life. Its pathological result is usually much more severe, and has been indicated when speaking of the anchyloses which occur, and the deformity which it produces is usually much more marked and intractable. Dyspnœa, palpitations, and interference with the abdominal viscera, though occurring in minor degrees in neglected juvenile cyphosis, are not uncommon in the senile forms of the malady. In this disease the patient carries the head bent forward, and in bad cases the chin touches the sternum, and the patient's spine is very much curved, so that he will generally require two sticks to walk with. As one would expect, this malady is more common in males, but I doubt not that many of

us have seen one or two old women thus severely deformed perambulating the London streets as match-women. In less severe cases, the subject can maintain equilibrium by bending the hips and knees, and carrying the pelvis backwards; but as the malady, which, in some cases, is due to

FIG. 47.—Severe cervico-dorsal kyphosis.

rheumatic arthritis or gout, progresses, the posterior spinal muscles are much weakened, and cannot replace the bent-forward spine.

Diagnosis.—The existence of the disease is not difficult to establish, but it is less easy to differentiate whether the malady be essential or symptomatic of rachitis, caries, gout,

or rheumatism. The form of the curvature will assist us in differentiating it from Pott's disease, because in the latter it is usually angular, whereas it is rounded in the former; moreover in Pott's disease one or more spinous processes stand out in a way quite different from that which occurs in cyphosis, though in some cases of caries the curvature is more rounded than usual. Pain is almost always present in some stage of spinal caries, whereas it is not a very common complication in the ordinary forms of cyphosis, unless this be due to rachitis, rheumatism or gout. Other symptoms will usually be present in Pott's disease; such as increased reflex movements, abscess, paraplegia, &c.

In rachitic cyphosis, other evidences of the general malady will usually be present; such as, enlargement of the epiphyses, beading of the ribs, &c.; but in rachitis, which is localized in the spinal column, the differential diagnosis becomes more difficult, and, as cyphosis is commonest in the dorsal region, if it be due to rachitis, the contraction of the middle part of the thorax, and the enlargement at its base, will aid us in arriving at a correct conclusion as to its ætiology.

It must be borne in mind that infants when put in the sitting position, always curve the spine posteriorly, and if they be large and heavy, and lax, this curve is more pronounced and must not be confounded with cyphosis. This natural posterior flexion disappears in dorsal decubitus, as does also an idiopathic incipient juvenile cyphosis. In infants, this posterior general curvature is due to lack of power in the muscles and ligaments to keep the spine erect, and is a temporary phenomenon which disappears as the child grows. Another diagnostic aid in rachitic cyphosis is the dyspnœa which usually occurs in them, and which results from the feebleness of the spinal muscles and the compression of the lungs by the deformed thorax

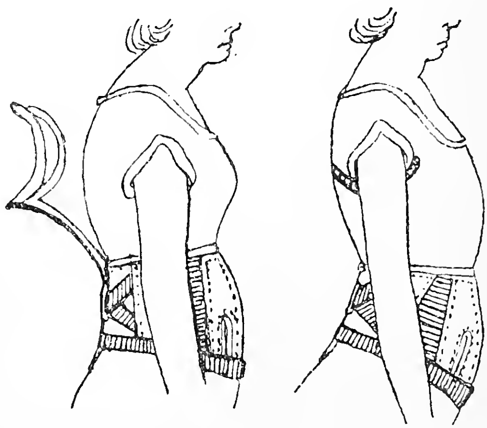
against the diaphragm. A simple method will aid in the diagnosis of the kind, and degree of curability, of the cyphotic curve. Place the infant on its belly, and lift it by its feet, then cautiously raise its pelvis, when rachitic curvatures will disappear and a little physiological lordosis will reappear. Those curvatures which have had time to become confirmed at the expense of the anterior part of the vertebræ, will not entirely disappear, but their amplitude and volume will become diminished. I have repeatedly put this observation to the test, and can speak as to its validity in cases which come to us in a comparatively early stage, but if rachitic cyphosis be well marked, and, especially if it be of the juvenile form, it is not so easy to make a marked impression upon the curve.

I have said so much regarding this disease, because such cases naturally come more frequently under the care of the orthopædic surgeon than that of general hospital surgeons or practitioners, but I would warn those of small experience in the treatment of deformities, never to forget that in most cases of posterior curvature occurring in infants or children, the deformity is due to caries, and not to any of the forms of cyphosis as I have defined the malady.

Prognosis.—This will depend upon the degree of the malady and its cause. The infantile and juvenile forms are usually quite curable if the proper treatment be adopted; as are also the senile forms in an early stage, but when anchylosis has taken place, little or nothing can be done, though some surgeons, such as Delore of Lyons, have gone so far as to break the anchylosis, and with a certain amount of success. I have only once as yet adopted this heroic measure, therefore I would not prejudge it without further experience, for it may be that there are suitable cases, and that such may derive considerable benefit. The symptomatic forms of the malady are

generally less amenable to treatment than the essential varieties.

Treatment.—In the first and second stages this malady is quite curable, but when anchylosis has taken place, the spine can only be very partially straightened, and then by very forcible and therefore dangerous extension. I have only once tried this plan, and the amelioration produced was encouraging. I think that there could not have been



FIGS. 48 and 49.—Diagram of dorsal kyphosis before and after application of a spring corrector.

bony anchylosis, or but a slight one, though considerable force was required to correct the mal-position, and a crackling noise was distinctly audible. No ill effects followed, and I think that in this affection, and in the second stage of scoliosis, this operation in cases deemed suitable, is quite justifiable so far as present experience goes. It is a very different matter to attempt straightening, as do some of the bone setters and quacks, in cases of Pott's disease, where paraplegia or other serious lesion to the cord may result: but in the disease just named, the only theoretical mischief which might accrue would be an inflammation

due to the rupture of strong fibres or ligamento-osseous bands, and it is possible that this might extend to the intervertebral substances, producing inflammation of them, and also ostitis and caries, but these are only *à priori* considerations. If operation be deemed not desirable, the treatment of this malady is *local* and *general*. The latter applies itself to the improvement of the health by suitable regimen and medication, whereas the former makes use of gymnastics and appliances which tend gradually to correct the deformity. There is one exercise recommended by Shaw and Andry which I have not found to succeed. It is to make the patient carry weights upon the head so as to exercise the enfeebled muscles, and encourage them to bring the spine into a better direction. It seems to me that the usual result is failure, as the spinal muscles are already so weak that the patients, unless forced, shun the proceedings. Auto-suspension by Sayre's apparatus may be tried, but I place more faith in improving the general health, massage, electricity, and supports. In the third

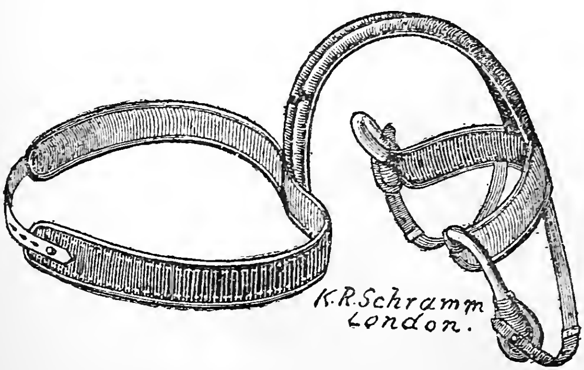


FIG. 50.—Nyrop's spring corrector.

stage, where bony anchylosis has occurred, our treatment can, as a rule, only be palliative.

Spinal Correctors and Supports.—The best of these

appear to me to be the spring support of Nyrop, and the apparatus of Lebelleguie. The former is shown in the accompanying figure, but it should be borne in mind that the supports are only adjuncts to the other treatment, and should be worn between-whiles; and I would also draw attention to the fact that they need modification according to special circumstances. Many other forms of apparatus have been devised; such as, Taylor's support for Pott's

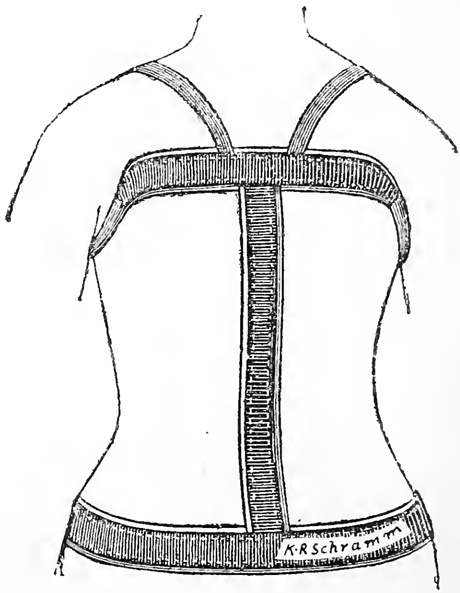


FIG. 51.—Nyrop's spinal corrector applied.

disease, and Duchenne's bandage, acting by elastic traction; but those I have recommended, and the accompanying figure of one made by Mr. Schramm, added to those already indicated, will serve every purpose in cases amenable to treatment. In infants, a leather posterior support properly padded will, with attention to its fitting, render aid in correcting this deformity.

Spinal Debility.—In delicate and rapidly-growing

children, and especially in girls, this condition is indicated most usually by a general or partial cyphosis. In some cases there may be combined flexion, or even slight atonic scoliosis. This abnormal condition of the spine is due to want of constitutional and local muscular tone, and is aggravated by bad positional habits. The spine can usually

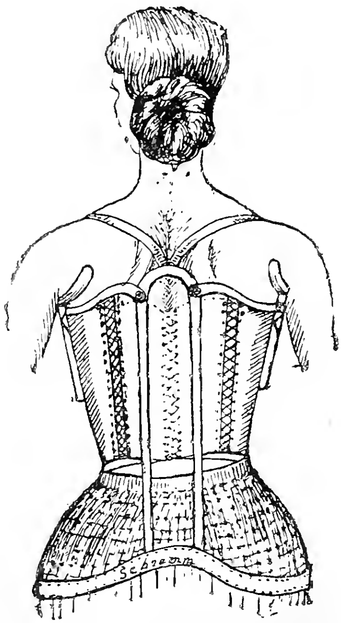


FIG. 52.—Apparatus for spinal debility.

be readily corrected by the surgeon or patient, but easily relapses into its former condition. The best *treatment* is by attention to the general health, fresh air, gentle exercise, and the exhibition of tonics. Locally massage, and electricity in some cases, are very valuable, and an instrument like Nyrop's, which acts as a spinal reminder, is very serviceable.

CHAPTER IX.

LORDOSIS.

Definition.—This malady consists in a marked hollow in the back, due to anterior curvature of the portion of the spinal column in which it occurs. It is less common than cyphosis, which latter is, as has already been pointed out, far less common than scoliosis.

Synonyms.—French, *Lordose;* German, *Vorverbiegung der Wirbelsäule*, *Lordotische skoliose;* English, *Spinal incurvation or anterior deformity.*

Varieties.—It may be *essential*, *i.e.*, *idiopathic*, or *symptomatic*, and is commonest in the lumbar region, though it may occur in the dorsal and cervical. Idiopathic lordosis is rare, and when it occurs is usually developed at an early age. Lumbar lordosis is common in some races, as among Cuban women, and the inhabitants of Terra del Fuego, and even in some Europeans there is an exaggeration of the normal physiological antero-posterior curve which must not be mistaken for lordosis proper. This also consists in a great aggravation of the normal curve in a subject previously not so deformed. Certain domestic animals, especially horses which have carried heavy weights upon their back, have well marked lordosis, and this condition can be readily produced by interbreeding. Syptomatic lordosis may be due to several causes, such as primary deformity of the lumbar vertebræ, congenital dislocation of the hip,

hip disease and anchylosis, or it may be compensatory to dorsal angular curvature, and is also found in very stout people with pendulous abdomen and fat omentum.

Causes.—Some of these have been given, so far as known, under the above heading. Certain occupations, such as carrying weights on the head, cause a balancing of the spine by throwing the upper part of the trunk back-

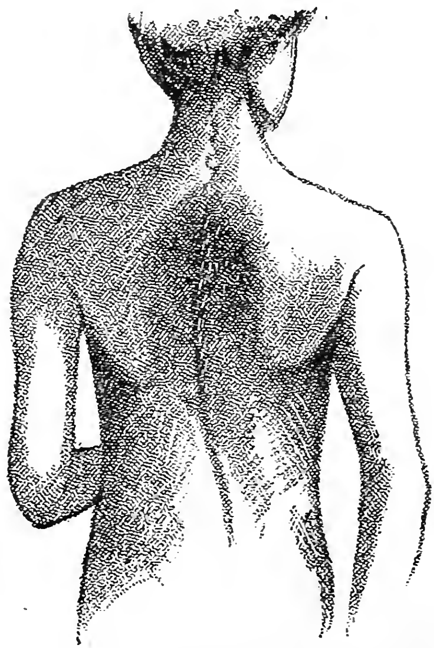
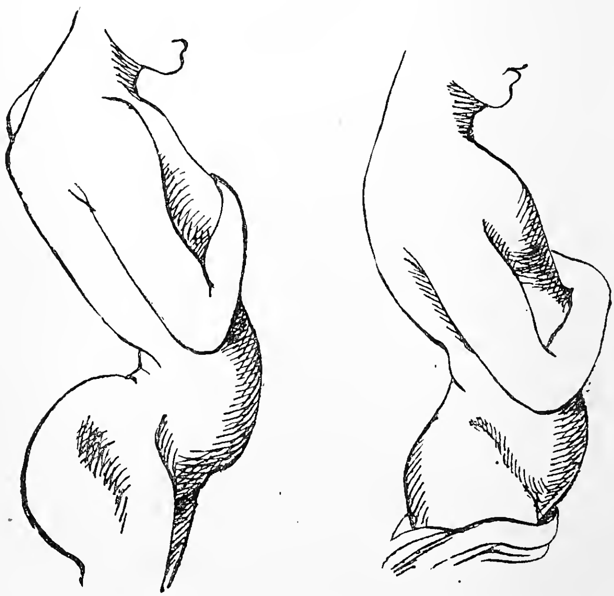


FIG. 53.—Upper dorsal lordosis in a boy aged 10.

wards, and produce what may be termed a *vocational lordosis*. Pregnancy will produce a *temporary* lordosis, whereas rapidly repeated pregnancies, partly by this mechanical effect, and partly by debilitating the constitution and abdominal muscles, may render it *permanent*. Large abdominal tumours, whether ovarian, uterine, or other will produce temporary lordosis, and contraction of the posterior

spinal muscles will also produce it, and, paradoxical as it may appear, paralysis of these muscles will also cause it.

Paralysis of the spinal muscles causes the patient to throw the trunk backwards so as to prevent its falling in the opposite direction, which tendency is induced by the action of the unaffected flexors. In these cases the buttocks are much diminished or nearly effaced, the pelvis is tilted forwards and upwards, so that a leaded cord passing from the occipital protuberance will hang well behind the



FIGS. 54 and 55.—Lordosis from paralysis of abdominal muscles (Bouvier).—Lordosis from paralysis of the pelvic extendors (Duchenne).

sacrum. If the abdominal muscles which act as flexors of the spine be paralyzed, lordosis will also result, but this is limited to the lumbar or lumbo-sacral region, and the leaded cord will come in contact with the sacrum because the pelvis is rotated so that its anterior spines look down and forwards, and the tubera ischii back and upwards.

Paralysis of the cervical muscles will produce cervical lordosis, and it matters little whether the disease affect the flexors or extensors. The mechanism of this is similar to that just explained with reference to lordosis due to paralysis of the adominal or spinal muscles. Congenital lordosis is extremely rare. Other rare forms are the temporary lordosis of infants due to reflex irritation from teething, worms, &c., and that resulting from central or peripheral nervous lesion or irritation. Instances of these are given in the next paragraph.

Symptoms.—These will vary according to the seat of the deformity. Cervical lordosis is very rare, is commonest in infants at the breast, and this is due to the debility of the anterior cervical muscles, which are not yet sufficiently developed to hold the head erect; but this is a mere transitory symptom, and cannot be considered a pathological cervical lordosis; but I have seen three well-marked instances, two of which occurred in infants, and one in a girl aged seven. In all of these the posterior cervical muscles felt harder than natural, and the occiput was approximated to the nape, and the chin projected. The infants were cured in from two to three months by correcting their diet, attending to the wrong condition of the alimentary canal, by frictions and massage to the muscles of the nape, and by a proper support. But in the girl, nearly six months elapsed before the deformity was cured, and here I had to call in the aid of electricity, local gymnastics, and a support to be worn day and night.

In lumbar or lumbo-sacral lordosis there is a great hollow in the lumbar region, the upper part of the body is thrown backwards, the buttocks project, and the walk of the patient is peculiar, and must be seen to be understood and remembered. The abdomen is prominent, the scapulæ are thrown back and upwards, and the shoulders back, in

the early stages, but when a compensatory dorsal cyphosis is formed, these latter symptoms are absent. If the patient be made to lie on the back, a marked arch will be observed between the buttocks and dorsal region. It will be understood that this deformity, if primary, causes a tilting forwards, and rotation of the pelvis on its transverse axis, so that in women an alteration of the pelvic viscera must occur; hence, these subjects are liable to uterine displacements and to troubles during childbirth, and it is well to instruct these women to lie on their back for some months before their expected confinement, with their thighs flexed upon the pelvis and supported by pillows. Symptomatic lordosis scarcely ever assumes so pronounced a curve as does the essential, or idiopathic form.

Fig. 56.—Paralytic lordosis in a male child from atrophy of spinal muscles.

Pathology.—The vertebræ and intervertebral discs of the part affected are higher in front, the spinous processes are diminished in height, as also are the articular processes and the laminæ, the posterior aspects of which become convex. The transverse processes are also approximated. In extreme cases, anchylosis of these vertebral processes may occur, but less commonly than in cyphosis. Anchylosis may even occur between the bodies, and this may be peripheral, occurring only at their margins, or central. In lumbar or lumbo-sacral lordosis, the sacral vertebral angle is increased, and the coccyx points upwards and backwards, so that the pelvis is rotated in the same direction. The pelvic brim becomes cordiform in shape and its

antero-posterior diameter is diminished, though in idiopathic lordosis, usually, no serious obstacle is offered to childbirth. The anus and the external genitals are carried backwards, and the uterus predisposed to ante-version.

Diagnosis.—The deformity declares itself. The only question is to ascertain its cause, and if it be symptomatic; this is usually not difficult. Many forms of the latter disappear on dorsal decubitus, or on standing, such as the paralytic, and those due to anchylosis of the hip, but if an attempt be made to straighten the thigh, lordosis is reproduced. In women, if uterine troubles exist, these will of course aggravate the symptoms, but usually the prognosis as regards the general health is favourable, and in cases of symptomatic lordosis, the deformity will diminish or disappear, if its cause be amenable to surgical treatment.

Treatment.—This consists in properly selected and guarded gymnastics, electrization of the abdominal muscles, recumbency, and the use of apparatus. The patient's bed or couch, if used in the daytime, should be so disposed that the head and shoulders, also the pelvis and lower limbs, should be raised above the intermediate region, which will thus tend to straighten itself. In lumbar lordosis a support with a pad pressing upon the secondary dorsal cyphosis, should be used in the intervals between the other modes of treatment. In paralytic cases, besides electricity, massage, and suitable medication, elastic or steel spring supports are of considerable service.

CHAPTER X.

VERTEBRAL OR SPINAL CARIES, OR SPONDYLITIS.

Definition.—This is a disease of the vertebral bodies or intervertebral segments which leads to their partial or complete destruction, and is completed by anchylosis causing posterior projection of the spinous processes. It is properly called *spondylitis* (from σπόνδυλος, a *vertebra*) and has also been called *Pott's Disease*, though other surgeons, and especially Camper and Sévérin, described it before him, yet not so accurately.

Synonyms.—English, *Angular curvature;* Greek, *Kyphosis;* German, *Spitzbuckel*, *Winkelförmige Knickung der Wirbelsäule;* French, *Cyphose*, *Mal de Pott.*

Varieties.—There are the lumbar, dorsal, and cervical forms of the disease, and when the malady affects contiguous regions, it is termed *cervico-dorsal* or *dorso-lumbar* accordingly. The pathological changes are the same in all these varieties. It may also be *acute* or *chronic*, the former running its course sometimes very rapidly.

Causes.—It was formerly believed that tubercle in the bodies of the vertebræ caused inflammation, softening, and decay, which spread to the intervertebral substances, and ate away the bodies, producing a cavity on the anterior or antero-lateral aspects of the affected portion of the spine which led to ultimate collapse, and the formation of a posterior projection; but the late Mr. Hilton, and Mr.

Holmes in this country, and Dr. Sayre of America hold that the mischief is very commonly set up by injuries, in fact the latter surgeon goes so far as to say it is always due to traumatism. He says,* "The most frequent causes of Pott's disease are concussions and blows. A child unusually active and playful may, in some careless prank, jump from a height in such a manner as to come down straight, with the lower limbs quite rigid at the knees and hips, and thereby give a sudden concussion to the bodies of the vertebræ, and the intervening cartilaginous discs, thus disturbing some centre of ossification to such an extent as to result in inflammatory action, and finally in softening and disintegration of bone. In consequence of a blow or fall, the heads of some of the ribs may be forcibly driven against their articular facets. In many instances direct blows are received of sufficient force to injure the vertebræ, and to excite disturbance of a serious character. Pott's disease occasionally originates in fracture of a transverse process of a vertebra, the injury remaining unsuspected, until at last it may be discovered quite by accident, in the *post-mortem* theatre, or the dissecting room. In many cases of angular curvature, the fact that any injury had been received prior to the development of the disease, has passed entirely unrecognized by either the patient or his friends, and has been revealed only after the most careful questioning. After such disturbance of one or more vertebræ, several months may elapse before attention is drawn to the case, and probably during this interval, the bones may have been partially destroyed through inflammatory softening and disintegration, and more or less distortion may have been developed. Any signs of exhaustion that may now be presented are regarded as evidence of constitutional cachexia, but erroneously so, since the

* "Spinal Disease and Spinal Curvature," London, 1877, p. 2.

exhausted condition of the patient is simply the result of long-continued suffering from a local disease, dependent upon some direct injury to the parts in fault."

I have given Dr. Sayre's views in his *ipsissima verba*, because, though I freely admit that injury may frequently be the actually known or the unrecognized cause of the disease, I cannot admit it as the only cause, and to the exclusion of others due to local and constitutional states. If we reflect on the many thousands of children in existence, and of the tumbles and hurts of various kinds which the majority must have in their childhood and youth, and compare them with the number of cases of Pott's disease met with in practice, whether public or private, we should see that one is out of all proportion to the other. Thus, even assuming that injury be the exciting cause in all cases, it appears necessary to call in a constitutional or local predisposition, to explain the occurrence of spondylitis in the instances in which it occurs after a hurt. We must all know of cases of severe spinal injury followed by perfect recovery, and of other cases in which a slight injury appears to have evoked spinal caries, so that the amount of traumatism does not appear to be a very important factor, and here again we are obliged to call in the aid of some predisposing cause. In the cases in which the force of the blow is transmitted through the ribs to the vertebral articular facets, it is more probable that an arthritis is set up which may spread through the processes to the vertebral bodies, and thus cause the disease. Of this I am sure, that in considering cases of spinal caries, we too often overlook the undoubted fact that disease of the vertebral joints may co-exist, or even be independently present. The fact that the disease is commoner in boys than in girls, lends support to the traumatic view, as they are more exposed to injury in their rougher games. It is but right, however, to

mention that Dr. Sayre admits the presence of constitutional tendencies in some cases where injury was the exciting cause.

Tubercle and syphilis are not infrequent causes of the disease; and ostitis with cheesy degeneration may follow the continued fevers, or be due to vital depression from some long or serious illness. This deformity may also be caused by cancer or tumours originating in, or extending to, the bodies of the vertebræ, or be due to the erosion caused by aneurisms. The deformity may also be imitated by gout and rheumatism, or occasioned by an ostitis and arthritis deformans. Fracture and dislocation also lead to posterior spinal projections.

Symptoms.—In its early stage these are often obscure, and consist chiefly in various local or distant pains, and reflex disturbances. This is due to irritation or pressure on the spinal nerves at the intervertebral foramina, and the situation of the mischief can be diagnosed in the præcyphotic stage by the pain in the side or front of the body which is not infrequently complained of. In the early stages of dorsal caries, pain along the intercostal nerves and abdomen, intrathoracic pains, palpitations, irregular breathing, and indigestion may be present, and cases not a few, might be quoted in which the patient has been treated for these symptoms rather than for the disease producing them. In lumbar disease, in its early stage, a feeling of constriction around the abdomen may be present, and a pain on deep pressure at the sides of the umbilicus; there is pain on walking, and on abducting the thighs, and not uncommonly, pain down the inner side of the thigh. There may also be constipation, flatulence and reflex irritations, so that such symptoms may be mistaken as due to worms. The bladder or rectum also may be very irritable. Any of these symptoms should lead to an examination of that

part of the spine where the nerves of these organs take their exit. In cervical caries in its early stages, there are frequently present, dysphagia, rigidity of the cervical muscles, and sometimes a feeling of strangulation. Laryngeal irritation may also be present, and pains at the upper part of the thorax. Another symptom in cervical or cervico-dorsal caries, in the early stages, is a slight torticollis or opisthotonis, and the sufferer dislikes holding the head erect or rotating it. There is a painful expression of face, and the patient walks with a peculiar gait indicative of great caution. Very soon a compensating posterior dorso-lumbar curve appears, which may mislead one into thinking this to be the primary affection. The shoulders appear raised, and the head sunk between them, and the latter is often supported by the hand of the patient. If the first or second cervical vertebra be affected, occipital neuralgia will frequently be present, as the great and sub-occipital nerves cross along this region.

Should irregular diaphragmatic action be present, the vertebræ through which the fourth and fifth cervical nerves emerge will be the parts diseased. Mr. Howard Marsh* correctly says that, as a rule, in cervical caries the pain is situated at a higher level, whereas in disease of the lower portions of the spine it is generally found at, or below, the seat of mischief. In later stages, retro-pharyngeal abscess may be present, and will assist in the diagnosis, and in the last stage, deformity will leave no doubt as to the nature of the malady. And this last statement holds true of disease in the other spinal regions. It should be pointed out, however, that pharyngeal abscess often causes laryngeal spasm and pressure, and if not opened early may lead to the necessity for tracheotomy.

Besides the vague pains which may be present in these

* *British Medical Journal*, June 11th, 1881.

cases, there are various reflex muscular contractions in the early stages, and these are noticeable in the various actions of the patient, in the way he walks or holds himself, or turns round. The joints of the lower limbs are bent so as to avoid any sudden concussion. The spinal, and often the abdominal muscles, are kept rigid and the shoulders elevated, in order to prevent movement between the vertebral bodies, and the patient's locomotion is extremely guarded. The spine is kept rigid so as to prevent movement and pressure on the vertebræ, which cause pain, and the patient when asked to stoop or take up anything from the floor does so in a peculiar way by first bending the hips, then the knees, until he reaches the object, when he raises himself by placing his hands on his knees or on some near object, such as a chair, and rises slowly, keeping the spine stiff the whole time. The respiration is also short and noisy, and the object of this rapid respiration is to throw less work on the muscles acting through the ribs on the affected vertebræ.

Another diagnostic aid is to ask the patient to rise from a chair, and in the case of a child it will be found that it will gradually and painfully slide down so as to avoid any spinal concussion, and an adult will rise by resting his hands on the sides or back of a chair, or on his knees. By questioning the mother, or observing the child at play, or getting in or out of bed, it will be observed that a slight jar produces an expression of pain, and the one with which I have been familiar at the East London Children's Hospital, and at the London Hospital is the cry of *Oh-er*. The behaviour of the patient during sleep will also furnish valuable information, as the child is often restless and moans or utters short cries when attempting to move, whereas in hip or knee disease, motion in bed is usually provocative of a sharp scream, without waking. If the

child be placed upon a bed or on the floor and asked to get up it will generally roll over to get up on the hands and knees, and then on the feet. The observation of children as they stand may furnish valuable observation, as they not infrequently rest one or both hands upon the thigh so as to support the spine through *collateral transmission* of weight. These remarks hold true simply of children. In adults there is of course less difficulty in eliciting information.

FIG. 57. — Lower dorsal (Pott's) and slight right morbus coxæ. Showing how these cases stand and fix spine by the hands on knees.

In the later stages, if the disease progress, we have *abscess* pointing in various directions, following or accompanying posterior deformity, and these will guide us as to the exact site of the mischief. If the disease progress partially, or completely, paralysis of one or both lower limbs may occur, or of the upper ones in cervical or cervico-dorsal mischief; but paraplegia is commonest when the disease is low down, and may depend either upon effusion around, or into, the cord, or on myelitis, or on vertebral displacement. Generally, this paralysis recovers sooner or later as the diseased process subsides, and I have recently seen a case, in an adult, of five years of paraplegia due to spinal caries which ultimately recovered and almost without treatment, except frictions of the affected limbs. In cases which are going to the bad, œdema of the lower limbs and lower part of the abdomen and of the genital organs may occur; or death may be ushered in by hectic

and exhaustion from the abscess, or through lardaceous disease caused by profuse suppuration. Tuberculosis also has resulted from prolonged suppuration. Bladder symptoms, and even the formation of calculus has been caused from a long continued recumbent position and the difficulty thereby caused in thoroughly evacuating the bladder.

In the *dorsal* region pain would be referred to parts on a level with, or below, the diseased region. The intercostal muscles act imperfectly and respiration is largely abdominal, but in the lower dorsal region abdominal pains are complained of and the child prefers the prone position. In the early stages the spine is rather incurved, but in later stages, when the bodies are crumbling away, the spinous processes begin to project and then the case is clear; but in its incipiency the peculiarity in walking and speaking and the rigidity of the column will guide us to the diagnosis of vertebral ostitis. In dorso-lumbar disease there is a fulness and sometimes fluctuation in the ilio-costal spaces before any bony deformity can be recognized.

In *lumbar caries* we have a guide through the condition of the psoas muscles, as there is often a preference for standing upon one leg, or a lameness of one or other limb with flexion of the thigh; but the motions of the hip are perfect and painless, at any rate in the earlier stages. These symptoms as well as abscess may appear before deformity.

As the disease progresses the deformity of the spine assumes various shapes, being sometimes curved, but more often angular. In the former, several vertebræ share in the projection, in the latter, the spinous processes of one vertebra is more prominent then those of the remainder. In the dorsal region, the natural curve of which is backwards, the projection appears sooner and the spinous processes project more than they do in other regions; whereas

in the lumbar region, which is concave posteriorly, the posterior deformity is much longer in showing itself, as the anterior lumbar curvature has to disappear before a posterior projection can be formed; but in the lower lumbar and upper sacral vertebræ a lordosis of the vertebræ above the disease is not an uncommon symptom preceding posterior projection. As the disease progresses the spinal

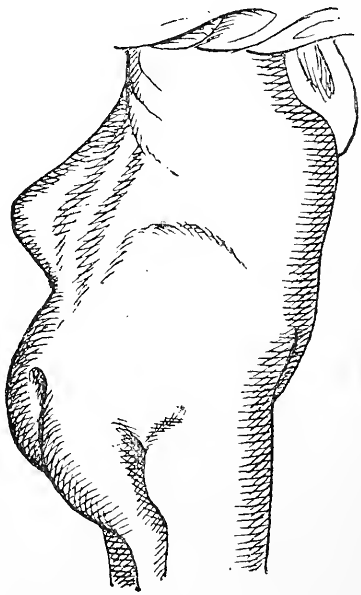


FIG. 58.—Lumbo-sacral caries and severe angular deformity.

muscles become atrophied and allow the angle or curve to become more prominent.

If the disease progress to the formation of abscess this may be recognized by certain general and local symptoms. The temperature rises and may even reach 105, as recorded by Shaffer. Pain along the course of the abscess is usually present, though there are not a few cases in which all the symptoms are obscure. There may be neuralgic pains in

the neck, along the intercostal spaces, or in the loins, groins, and thighs, according to the region of the disease; and in lumbar disease the peculiarity of standing and walking and the position of the lower limb, already alluded to, will be present, and it will be found that the patient can go better up, than down stairs. Psoas abscesses may open down the thigh and leg, or may ascend on the abdominal muscles, or may even pass along the inguinal canal and be mistaken for an inguinal rupture, and they may pass over the iliac crest and open on the gluteal muscles. They may also pass out through the sacro-sciatic foramina, or may burst into the bladder or rectum. In the next paragraph on pathology I mention a case of cervical disease and post-pharyngeal abscess, the latter passed into the posterior mediastinum and caused fatal pleurisy; and I also had a case of syphilitic caries at the London Hospital a few years back in which the boy coughed up portions of vertebræ which had penetrated the lung. The abscesses are sometimes of considerable size, and I have known a double psoas so distend the abdomen and pelvis of a girl as to be mistaken for ascites, ovarian, or other tumour; and a case has recently been recorded in the *Lancet* in which abscesses following spinal caries enormously distended the abdomen. Not long since I had a case, aged 50, at the Hospital for Women, of a hard tumour in the right iliac fossa, which caused great pain in the hip and thigh. The patient could not walk, and was obliged to be gently turned in bed, and even this caused great pain. There was no spinal deformity and but very slight complaint of backache. The pelvic swelling had been variously diagnosed, and at one time, seeing that there was some œdema of the leg, I was inclined to regard it as malignant. In a few weeks fluctuation became evident, and pus accumulated below Poupart's ligament and I evacuated it. The diagnosis was

then clear. I saw this woman seven months afterwards, and a swelling had formed on the opposite side, so that she was the subject of *double psoitis.* Deformity was scarcely perceptible.

Sometimes psoas abscess opens into the hip-joint by means of the sub-psoas bursa, which occasionally communicates with it, and inflammation and abscess of this bursa, by the pain occasioned along the psoas and sometimes referred to the back, may cause diagnostic difficulty, and especially if the abscess point, as it may do, in the usual position of psoas abscess. There are some cases of lumbar caries and double hip-disease which may be independent, or may own the cause of bursal complication just indicated. It must also be remembered that there are rare cases of *dry* osteitis, periostitis, and arthritis in the spinal as in other regions.

Secondary deformities, and combinations of caries with lateral curvature are not infrequent. There may be compensatory lordosis above or below a posterior angular deformity, and the arch of the curve or projection may take a lateral direction. In such case it would show that the disease had affected the antero-lateral parts of the vertebræ on the side towards which the deformity projects. When the disease occurs before the bones have set, secondary pelvic deformities may arise and may be mistaken as due to rickets.

Cervical caries has for its earliest symptoms stiffness of the neck and pain on movement. There is pain on gently pressing the palm on the vertex and in the nape. As the disease advances, coughing, sneezing, swallowing, and any kind of motion produces pain. In disease of the lower half of the cervical spine paralysis of one or both arms or of the trunk and limbs may supervene if pus or displacement compress the cord. Severe hiccough may result and

be due to irritation of the phrenic, or severe palpitation may exist. The patient cannot rotate the head, but turns the trunk round on the femora, or moves round on the feet. The symptoms of disease high up in this region have been given when dealing with osseous and articular torticollis; but it must always be remembered that thorough fixation of the diseased part is absolutely necessary to prevent dislocation and sudden death from compression of the medulla.

Pathology.—The pathological process may in its commencement be either *peripheral* or *central.* In the former, it generally commences as a periostitis, leading to a superficial suppurating ostitis; in the latter, the disease commences in the centre of the bone, and is entirely independent of the periosteum. In the peripheral forms the periosteum becomes first thickened and then loosened from its attachment, and beneath this, new bone becomes deposited. Spinal caries may be dry or suppurative, the former being rare and commonly due to gout or rheumatism. Shaffer is of opinion that *caries sicca* affects many vertebræ and leads to a posterior curvature, whereas in suppurative caries the disease affects but a few vertebræ. The deformity is, as a rule, angular. Scrofula and syphilis, with or without injury, are supposed to be the causes at work in the production of the disease. In the destructive process the salts of lime are absorbed by the newly formed vessels and the cancellous tissue and medulla, in which are migratory cells and osteoclasts, gradually erode the bones, which, though swollen in the early stages, become very light and ultimately their compact or cortical substance is eaten away. In the dry forms interstitial granulations wear away the cancellous tissue and cause extensive deformity, of course without suppuration. Billroth is of opinion, from the study of excised joints, that this form is almost never seen *post-mortem*, as the granulations would break

down into pus during the very low state of the patient which precedes death. Cases are recorded in which the mischief began in the anterior common ligament; and I have seen one *post-mortem* in which it was confined to the intervertebral substances, but these appear to be exceptional.

As the disease progresses it spreads up and down, and may affect the dorso-costal as well as the spinal articular processes. The *post-mortem* appearances of the spinal cord and its membranes vary; it may be only slightly compressed

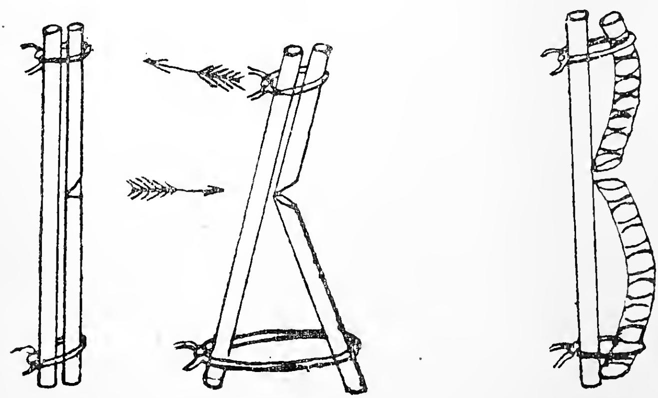


FIG. 59.—Diagrams of how a carious spine is straightened by instruments properly adapted. The two left figures are according to Taylor; the right according to Vogt, and is more correct.

or not at all altered in shape. The membranes alone, or the cord also, may be in various stages of inflammation, or of induration, or of suppuration and softening. If the displaced bone press upon the cord, symptoms of irritation and constriction of the parts affected are present during life; but as a rule these disappear, as the projected part of bone becomes absorbed and rounded off in time, and the angle that is formed in the cord to accommodate itself to the altered shape of the spinal canal does not usually affect its functions, because the slowness of the process permits the

medulla to become accustomed to its altered position. As the bone breaks down suppuration increases, and abscesses form and pass in certain directions which will vary with the seat of the disease. In the *cervical* region they may be retro-pharyngeal, or may open at the front or back of the sterno-mastoid, or more rarely, towards the back of the neck; and I have known an abscess to follow the course of the œsophagus, and cause pleurisy, pyothorax, and death. If the disease be in the dorsal region, pus may point in the inter-costal regions, or may gravitate to the loins, and in lumbar caries matter usually points along the course of the psoas muscles, of one or both sides, according to the site and extent of the mischief. It may not extend beyond Poupart's ligament, and is then termed *iliac* abscess; but if it pass into the thigh it is usually called *psoas* or femoral abscess. Pus due to lumbar or dorso-lumbar caries may pass between the planes of fasciæ attached to the corresponding vertebræ and appear in the loin, and is then known as *lumbar* abscess.

Diagnosis.—Most of the chief diagnostic points of the disease, as affecting the various regions, have been pointed out when speaking of the symptoms, therefore here it will only be necessary to speak chiefly of differential diagnosis. In the first place, we must remember that this disease is commonest in children and young people, and if we recollect that at puberty, and in girls for a short time after, the natural adult spinal curves are not completely formed, we shall be alive to the fact that in a highly-flexible column various *appearances of deformity* may arise, and especially in the more movable parts, such as the lumbar region. These should not be mistaken for caries. Such deviations may be diagnosed by placing the patient on the belly and raising the pelvis, when they will disappear, and no pain will be complained of; whereas, if caries were present,

there would be pain and rigidity of the spine. The attitude of the patient, his movements when turning in the sitting or lying posture, will show what part of the spine is rigid. The old plans of jolting the patient, of pressure and percussion, of application of heat along the spine, are fallacious and mischievous, as, though disease be present, they may cause no pain, and the means adopted elicit pain without disease existing. If, in females, much pain be complained of, or if slight touches produce pain, we should always suspect hysteria, and by applying the other tests there will be little difficulty in arriving at a satisfactory diagnosis. Hysterical paraplegia should not now-a-days give rise to much diagnostic difficulty.

The symptoms of spinal caries may be simulated by various maladies, such as nephritis from various causes, peri-nephritis, peri-typhlitis, cancer, sacro-iliac diseases, pelvic cellulitis, aneurisms in the thorax and abdomen, hip disease, and cervical, thoracic, abdominal or pelvic neuralgia. Dr. V. P. Gibney, in an excellent paper,* publishes a case in which the malady was first thought to be a sprain, and five months later to be a sub-acute dorso-lumbar meningitis or coxal neurosis; two years after it was pronounced an idiopathic iliac abscess, a month later it was thought to be lumbar caries with psoas abscesses, and at the time of his writing the paper the diagnosis was doubtful. Another case was at first supposed to be hip disease, a month afterwards to be lumbar disease with psoas abscess, and at the end of the year there were no signs of any disease. I mention such cases to show, not only that the symptoms may be obscure, but that they will vary according to the stage of the maladies causing them. Whenever there is multiple bone or joint disease the spine should always be examined, as cases, not a few, have been ob-

* "The Diagnosis of Pott's Disease of the Spine," &c. 1882.

served and recorded in which it became affected secondarily or concurrently with these. Cancer, sarcoma, and chondroma may originate in the vertebra, or extend to it, giving rise to diagnostic difficulty, as many of the symptoms are common to them and caries; but the age of the patient is usually a valuable guide, as, with the exception of sarcoma, and sometimes of chondroma, these affections are commonest in later life, though it must be remembered that caries may occur in advanced years. Pain and cachexia are probably the two most helpful signs, when combined, of malignant vertebral disease.

Prognosis.—Before Pott's time this disease used to be very fatal, and chiefly on account of the violent methods of extension which were adopted; but now-a-days, judging from hospital records, death from spinal caries is quite exceptional. This is partly due to the early recognition of the disease and the adoption of proper treatment, and in no small measure to the abandonment of all violent means, as formerly employed. In the early stages correct treatment will cure the disease without any, or but little, deformity, and even when abscess is formed recovery is the rule, if these abscesses do not involve any important viscera, but burst spontaneously and continue to discharge. Death may sometimes result from septicæmia, hectic fever, lardaceous disease of the viscera, or tuberculosis. Death may also be caused by involvement of the spinal cord and its membranes, or by direct pressure of displaced bones upon the cord, and has even been due to spinal hæmorrhage. Such cases are, however, comparatively rare. The duration of the cure will vary according to the stage at which the patient applies for treatment and the condition of his health at that period.

Treatment.—This is *constitutional* and *local*, the former consisting in good air, food, rest, tonics, and cleanliness,

with the occasional exhibition of alteratives if necessary. The local treatment consists in the judicious use of various surgical means, such as rest to the spine, either by means of recumbency in the supine or in the prone position, or by spinal supports during the greater part of the day. The question of the amount of recumbency must be settled according to the stage of the disease and the local and general condition of the patient. I can also recommend Rauchfuss's spinal cradle, as shown in the accompanying figure, as it combines rest and extension, and the patient may rest in it in the supine or prone position, the head

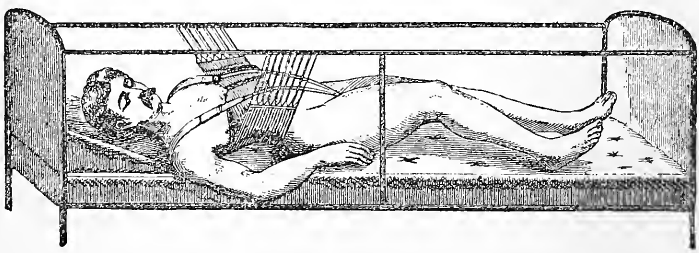


FIG. 60.—Suspensory cradle for rest and extension during recumbency.

and shoulders being supported by pillows and the limbs acting as counter-extendors.

The plan which many years' experience has convinced me to be the best is to have a moulded back-splint made of leather, felt, or gutta-percha, and covered with wash-leather, accurately fitted to the patient's back. This should fasten above over the shoulders and below round the pelvis, leaving the thorax and abdomen free from compression. The patient should lie on his back on a firm mattress in this spinal support and from time to time the supine should be changed for the prone position. I am, of course, now speaking of dorsal and lumbar caries. In more severe cases a water or air bed may be placed beneath the mat-

tress. In private cases the mattress should be so arranged as to be easily removable into an invalid-carriage or perambulator. It should be always borne in mind that the object of recumbency is to give complete rest to the diseased spine, and, therefore, all movements should be restricted as much as possible; and in lumbar disease, in children, it is often a good plan to pass a bandage over

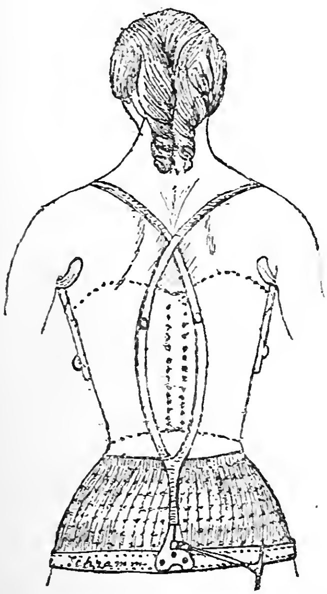


FIG. 61.—Support for dorso-lumbar caries.

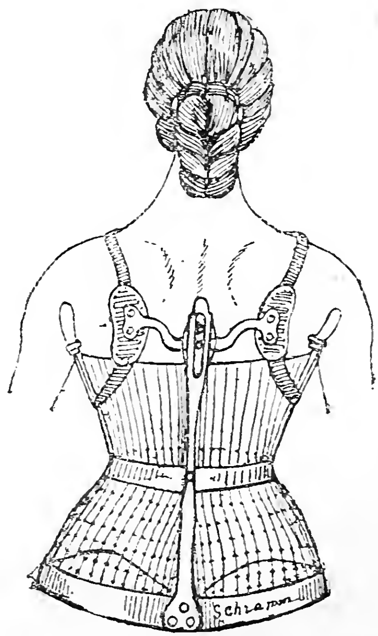


FIG. 62.—Support for fixation and counter-extension in dorsal caries.

the thighs, so as to prevent their being moved and causing traction and irritation on the psoas muscles.

Spinal Instruments.—When the disease has sufficiently advanced towards anchylosis a properly fitted instrument should be worn, and slight locomotion alternating with recumbency may be daily allowed and gradually increased as the symptoms indicate. The indications to

be fulfilled by these machines are (1) to support the diseased portion of the spine, (2) to remove superincumbent weight, and (3) to prevent increase of deformity. They have been made of various forms and materials, and their name is legion. I need not occupy valuable time and space by entering into these, but will content myself with recommending the forms which experience has taught me to prefer, remarking that I am not at all prejudiced in the matter of instruments, provided the indications already given be fulfilled by them.

I do not intend to enter into any lengthy discussion of Dr. Sayre's method of treatment by suspension and the plaister of Paris jacket, as I spoke at some length on this subject at the meeting of the International Congress in London, though I did not respond to the Secretary's desire to put my remarks into writing, so that they have not appeared in the Volume of the Transactions; but I may briefly say that our experience at the Royal Orthopædic Hospital has conclusively shown this plan to be worse than useless in lateral curvature, as it loses valuable time, and that in caries the increase of height gained by extension disappears in a few hours after wearing the jacket. I do not think that suspension should be used when the disease is active or when there is much destruction of bone, as it is then undoubtedly dangerous. That the jacket does not prevent the formation of abscesses, and that it may cause sores and sloughs—even when applied by Dr. Sayre himself—we have had proof. In hospital practice, where time and expense are objects, and in cases in which anchylosis is proceeding favourably, I think the jacket a cheap and efficient support, if properly applied; but I would do away with extension altogether in spinal caries, because it is mischievous in the active, acute, and destructive stages, and when anchylosis is pro-

ceeding it is not necessary, and may be harmful. I believe there is no need for me to say any more on the subject now-a-days, as, I believe, the general consensus of opinion of British practitioners, and certainly of orthopædic surgeons—those most qualified from large experience to express a competent opinion on such a subject—is against Sayre's plan, and his method of treatment has fallen a good deal into desuetude in these countries. *Felt* jackets are useful,

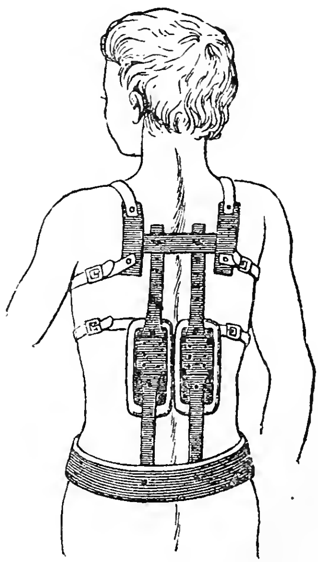


FIG. 63.—Taylor's support for lumbar caries.

but they are as expensive, and more so, than a properly constructed mechanical support, and, to my mind, less efficacious.

When the *cervical*, and especially the upper-cervical, vertebræ are affected, absolute rest, with the head or neck supported between pillows or sand-bags, is necessary for a long period, and when repair of the bones has sufficiently advanced, a collar, or Minerva, or, in poor patients, a

plaister-jacket and jury-mast are very serviceable. Some of these machines are represented in the section on osseous torticollis.

The surgical treatment, beyond the local measures already enumerated, consists in the treatment of abscesses, or in the *direct treatment*, where practical, of the diseased bones. In the early stages it is possible to procure absorption, and I have seen abscesses slowly disappear; but, unfortunately, this is not the rule, and then they need repeated aspiration, or may be opened by a valvular incision, or by a trocar and cannula. Precaution must be taken to prevent the entrance of foul air, and those who prefer it may adopt, in hospital practice, Listerian precautions. I had for several years before the appearance of Mr. Callender's paper, opened psoas, lumbar, and other abscesses, and hyper-distended them with injections of carbolic solution, Condy's fluid, and other disinfectants. Mr. Julius Cæsar, who was House Surgeon at the East London Children's Hospital at the period adverted to, can verify this statement, but as I did not draw public attention to the method, the merit of priority must be accorded to the late Mr. Callender. It is well not to interfere unnecessarily with these abscesses, as they often remain dormant for months without necessitating any special treatment, but among the poor, where the patients are allowed to go about as long as they can, not only do they sometimes open quickly, but, curious to relate, many of these cases end in anchylosis, with or without great deformity, in a perfectly marvellous manner.

Posterior incision of spinal abscesses.—J. & E. Bœckel in Germany, and Israel and Reclus in France, cut down on psoas abscess through the loin, a few years ago, and removed carious or necrotic bone, and Mr. Treves has introduced the plan into this country, and given anatomical guides for its performance. His paper will be found, in abstract,

in the Proceedings of the Medico-Chirurgical Society of London for this year. Mr. Chavasse has lately drawn attention to a similar plan adopted by Mr. Chiene, of Edinburgh, and his paper appeared in the *Lancet* before Mr. Treves read his paper at the above-named society. I have operated on one case with temporary benefit. No loose bone was found, but the cavity of the abscess was scraped as far as possible, and washed out. The operation was done some months ago, and the boy is still in the East London Children's Hospital, suffering from diarrhœa, and is in a very emaciated condition. The disease was dorso-lumbar, and there were sinuses in the loin.

If thought necessary or desirable, spinal abscess in the *dorsal* region may be reached by an incision along the rib passing down and out from near its angle; a portion of the rib of sufficient extent may be removed, and the abscess cavity reached, and the bone dealt with as may be required. The cavity can then be scraped and drained.

Cervical abscess and necrosed or carious bone can be reached, if high up, through the mouth, and if lower down, by an incision as for external œsophagotomy.

This method of surgically dealing with spinal abscesses is yet quite young and on its trial, but it seems to be a good and rational proceeding in cases where such a method is clearly indicated, though, from what I have heard and seen, the cases, so far, have only been temporally benefitted, and several have succumbed. I have also known the operation to be left incompleted by a surgeon who had some experience in it.

PART III.

DEFORMITIES OF THE LOWER LIMB.

CHAPTER XI.

TALIPES OR CLUB-FOOT.

Definitions.—*Club-Foot* or *Talipes* signifies an abnormal position of the foot, or its parts, in its anatomical relations to itself or the leg, and this abnormality may consist in a flexion, extension, abduction or adduction. In the majority of cases the muscles and their tendons, and the ligaments and fascia will be found contracted and retracted.

Synonyms.—German, *Klumpfuss;* Latin, *Pes contortus;* French, *Pied bot.*

Varieties.—There are six typical forms, viz., 1. *Pes Varus*, in which the inner-side of the foot is raised, the anterior portion of it adducted and the sole turned inwards. 2. Its opposite, *Pes Valgus*, in which the outer-side of the foot is raised and the sole everted. 3. *Pes Equinus*, in which the heel is raised, and the subject walks on the balls of the toes. 4. Its opposite, *Pes Calcaneus*, in which the toes are raised and progression occurs at the heel. 5. *Pes Planus*, in which the sole rests on the ground, the arch of the foot having sunken. 6. *Pes Cavus*, the opposite of planus, in which there is a great hollow in the sole,

the arch being much increased. These are the *simple* forms, but combinations of them form the *compound* forms, such as equino-varus and valgus and calcaneo-valgus. Not infrequently at large special institutions, mixed forms are seen, such as valgus of one foot and varus of the other, or calcaneus and varus, &c. Any of these forms may be either *congenital* or *acquired*. Among the congenital, the compound form equino-varus, is the commonest, and valgus and planus are the commonest of the forms affecting adolescents and adults. Cavus is almost always an acquired deformity. Of these, equinus and calcaneus are produced through the tibio-astragaloid or ankle-joint, whereas varus and valgus are brought about by changes wrought in the tarsal bones and joints.

Relative frequency.—This is a matter upon which some writers differ. Most of them, especially compilers, have followed some recognized authority, and said that varus is the commonest deformity; but this is a decided error, as the most frequent form of congenital club-foot (and these are the commonest of cases) is the combined form *equino-varus*. The statistics of Lonsdale, Tamplin, Chaussieur, Lannelongue, and Duval give the following results:—Of 495 cases of club-foot, Lonsdale observed 396 which he calls *primitive forms*, *i.e.*, *typical* forms; 73 of the compound forms; and 26 of the mixed forms; but it must be borne in mind that Lonsdale's varus, as that of all authors succeeding him, is equivalent to equino-varus. Of the primitive forms varus was the commonest, then valgus and equinus about equal—setting aside the causes —and calcaneus was uncommon. When speaking of the compound forms, he says he has only observed five cases of equino-varus of both feet against fifty four of varus of both feet—a statement which very much puzzles me. Males were much more frequently affected than females.

Tamplin, out of 10,217 cases of deformity treated at the Royal Orthopædic Hospital, only met with 1,780 club-feet, of which 754 were congenital.

Chaussieur noted 132 infants, out of 23,923 newly-born, affected with various deformities, and thirty-seven of these had club-feet, but the nature of the abnormality is not made clear.

Lannelongue says that, of 15,229 births at the Paris Maternity Hospital from 1858–67, there were 108 deformed infants, of which eight had club-feet.

Duval's statistics show that of 1,000 club-feet, 574 were congenital; 364 occurring in males, and 210 in females. He also gives the following account of club feet :—

		Boys.	Girls.
Equinus and equino-varus	417	215	202
Varus	532	302	230
Valgus	22	14	8
Calcaneus	9	6	3
Extreme calcaneus	20	13	7

It will be observed that these statistics agree with those of Lonsdale with regard to the much greater predominance of club-foot in males. From my experience of ten years at the Royal Orthopædic Hospital, I am sure that equino-varus is the commonest congenital form—that is to say, that the heel is drawn up by a shortened tendo-Achillis, and that the tibialis anticus, posticus, and flexor longus digitorum are contracted, producing the characteristic deformity. Congenital valgus and equinus are either simple, or combined, and far less common; but congenital equino-valgus is commoner, in my experience, than either of them. Calcaneus is comparatively rare. Dubreuil says that congenital varus is much rarer than equino-varus, a statement diametrically opposed to all my experience, so

that I may say that the so-called *typical*, *primitive*, or *pure* forms of the malady are rare, in my practice, as *congenital* deformities.

Classification.—V. Duval proposed a classification and nomenclature with long Greek words, which I need not occupy space with here, as it is more a question of terminology. Bonnet proposed a classification founded on normal anatomy and physiology, but which will not stand pathological test. Observing that, usually, varus is associated with equinus, and valgus with calcaneus, and that, in the first place, the affected muscles are supplied by the internal popliteal, whilst, in the second, the contracted muscles are supplied by the external popliteal, he established two kinds of club-foot, viz., internal and external popliteal club-foot, and in this he has been followed by Mr. Richard Davy; but Malgaigne, a long time since, shattered this theory by pointing to the fact that typical calcaneus exists, and that this is a contradiction to Bonnet's theory, and also that the tibialis anticus, though supplied by the external popliteal, powerfully contributes to inward deviations of the foot.

Causes.—It has already been said that club foot may be *congenital* or *acquired*, and the causes will vary concurrently. There can be little doubt of the power of *heredity* in some instances, and I have known several striking illustrations in which some form of club foot, and generally the commonest form, equino-varus, ran through various members of the same family. Consanguineous marriages are also said to be productive of deformities generally, and this kind among them. The various theories as to the causes of congenital club foot may be arranged under three heads: 1. *Mechanical;* 2. *Muscular;* and 3. *Osseous* malformation, or arrest of development.

Hippocrates, Paré, and Cruveilhier were supporters of

the *first* view, and thought that abnormal pressure of the uterus on the fœtus through deficient liquor amnii, or compression of the uterus by another part of the fœtus, or the abnormal position and action of the umbilical cord or of the amniotic bands, would produce club foot. But against this view the objections were that in most cases of club foot it is impossible to find any compressing cause, either external or internal. Mr. Silcock and Messrs. Parker and Shattock have recently advocated the view of mal-position in utero as producing the deformity, and the dissections and microscopic examinations of the latter gentlemen show, that from two cases examined, they regard congenital club foot as due to mal-position in utero; but this only indicates to me that in these two cases muscular or nervous change could not be detected by the microscope, and also that disease may exist and be beyond the ken of even the highest optical powers yet known.

The *muscular or musculo-nervous theory* was maintained by Duverney, Rudolphi, Béclard, J. Guérin, and subsequently by Delpech, who also was among the first to consider the deformity as due to malformation of the *tarsal bones.* This theory supposes an unequal action of the muscles and ligaments, or an insufficient development of the calf muscles, or a disease of the nerve centres. Rudolphi attributed it to intra-uterine convulsions, and Chance and Little are somewhat inclined to support this view. Guérin stoutly supported this theory, and considered club foot as the result of convulsive muscular retraction consecutive to affection of the central nervous system, leaving, sometimes, manifest traces, and at others, none whatever. There can be no doubt that where other deformities are present, such as spina bifida, &c., club foot has not infrequently been found to co-exist; but on the other hand, many fœtuses with considerable destruction, or want of development of

the nervous centres, have been examined, which were devoid of club foot. Lannelongue found thirty-two fœtuses affected with congenital defects of the sexual and nervous centres, of which only four had club foot. Chaussieur relates thirty-seven cases of club foot, perfect in every other respect, so that the nervous theory does not yet appear to be sufficiently established; and though the muscles are found contracted and retracted at birth, sufficiently in severe cases to have produced alteration in the bones, still this muscular contraction may be secondary, and due to mal-position *in utero*.

The *theory of primitive osseous deformity* and arrest of development has had weighty names in its support: Scarpa, Broca, Robin, Lannelongue and Thorens support the view of original osseous deformity; whereas Meckel, Geoffroy Saint-Hilaire, Breschet, and Eschricht upheld the view of arrest of development, and thought that at a certain period of intra-uterine life the infant's feet were in a position of varus, and there can be but little doubt but that this is more or less the case; but it must be remembered that if this explains varus, it throws no light on the other forms of club foot.

At present the ætiology of the subject is obscure, and the most that can be said is that the mechanical, or mal-position theory, appears to be the more probable, though far from demonstrated. I am inclined to think that the causes of club feet are not single and invariable, and there can be little doubt that *acquired* club foot, and such as those of which all experienced men must have had the opportunity of watching the development, are undoubtedly due to affections of the nerves, muscles, fascia, &c., so that, for my own part, I see no difficulty in believing that if the nervous system were disturbed during intra-uterine life, and affected the muscles acting upon the foot, these might

readily induce alterations of the cartilaginous predecessors of the tarsal bones in the congenital forms.

PES EQUINO-VARUS.

Synonyms.—German, *Klumpfuss;* French, *Pied bot varus.*

This may be *congenital* or *acquired.* The former is the commonest variety of club foot. Before proceeding to the pathology of the affection, it may be well to say a few words regarding the normal form of the fœtal foot. In it the plantar arch is but little formed, the sole of the foot is turned in, and the anterior part slightly adducted, but the peronei are capable of turning the sole outwards. To distinguish the former natural position from slight cases of club foot, the infant should be placed near a fire, and if the foot be normal, the child will flex the thighs upon the abdomen, the legs upon the thighs, and turn the feet out; but in equino-varus, it will not be able to evert the foot.

In this deformity the anterior part of the foot is adducted, the inner border is raised upwards, and is concave with a crease at the transverse tarsal joint; the external border is convex and looks downwards. The heel is raised by the contracted tendo-Achillis, which draws the os calcis up and back, and is generally small. In severe cases the plantar fascia is also contracted, forming a marked cutaneous crease in the sole. The foot is generally shorter and broader, and very commonly the great toe is drawn inwards from its neighbour. The internal malleolus is hidden, and in severe cases imperfectly developed, and appears to be too anteriorly placed, whereas the external is prominent and appears to be displaced backwards. On the dorsum, the upper portion of the head and neck of the astragalus are seen and felt to project.

In *neglected varus*, that is to say, when nothing has been done for the deformity until the patient is several years old or reaches the adolescent or adult stage, progressive changes have occurred, and the deformity is considerably increased. In the plantar region and inner side of the foot two deep grooves are observed, one longitudinal and the other oblique. The former is placed near the anterior part of the foot, and the latter near the posterior, the longitudinal furrow being caused by the fourth and fifth metatarsal bones folding under the others. In walking, the subject rests the dorsal surface of the foot on the ground, the skin becomes thickened and bursæ form, which may inflame and cause serious trouble. The leg muscles waste, and sometimes the tibia *rotates* on the vertical axis, so that instead of, as in the normal condition, a vertical line passing through the patella and prolonged downwards passing through the middle of the anterior tibial tuberosity, it passes to its outer side. In other cases there is *torsion* of the tibia rather than rotation, so that its upper part appears normally placed, whereas its lower may be carried either from within out, or from behind forwards; or from without in, and from before backwards. Scarpa observed the former mode of torsion, in which the internal malleolus was carried forwards, and the external backwards. In the latter mode of torsion the external malleolus is in front, and the internal behind.

CONGENITAL EQUINO-VARUS.

Pathological Anatomy.—The various structures forming the foot are more or less altered in well-marked cases of congenital varus, and the amount of deviation from the normal will depend on the severity of the case, and the length of time it has remained untreated; but it may also

be due to mal-development of the bones and other structures of the foot.

Bones.—The *astragalus* is in a state of extension, and the lower surface of the tibia is not in contact with its anterior part, but only with the posterior part of its articulating surface. The head of the astragalus appears to be carried down, in, and forwards, and its neck has on its outer side a tubercle separated by a groove from the scaphoid facet. Its upper surface is smaller than natural, and its posterior aspect is atrophied. It is also *rotated* on an antero-posterior axis. The *scaphoid* is drawn up, in, and back by the tibials, and its tuberosity is close to, and sometimes articulates with, the anterior malleolus. The *cuboid* is rotated from above down, and from within out, and its upper surface becoming antero-inferior, rests on the ground in standing or walking. The *os calcis* is also rotated on an antero-posterior axis from above down, and from within out, and both its anterior and posterior extremities are carried inwards. An articular surface, divided into three facets by slight creases, is found at the junction of its internal aspect (now become superior) with its superior surface (now become antero-external). The external facet corresponds to the facets on the external malleolus and under surface of the tibia, the middle one corresponds to the body of the astragalus, and the internal one is in contact with the infero-internal part of the head of the astragalus. Its tuberosity is turned outwards.

The *cuneiform*, *metatarsals* and *phalanges* are turned inwards, and the metatarsals tend to spread out towards their heads, so as to broaden the anterior part of the foot. The *malleoli* are, in the majority of recent congenital cases, quite normal, but in those of long standing the inner malleolus may, through pressure from the scaphoid, be arrested in its growth. The fibula is often slender, and

bends inwards towards the tibia, narrowing the interosseous interval.

Articulations.—In consequence of the changed position of the bones, their articular relations are more or less altered, and new ones are also formed. The condition of the tibio-astragaloid joint has been given, and that of the astragalo-scaphoid is drawn inwards, and the scaphoid being partly displaced from without inwards, the anterior and inner part of the foot is drawn more inwards than the outer. The astragalo-calcanean articulation, instead of having its chief axis antero-posterior is transverse to the axis of the leg, and this, though allowing the ordinary movements of flexion and extension, does not usually admit of abduction, adduction, or slight rotation.

Fig. 64.—Diagram of a normal foot and one in equino-varus, to show the internal deviation of the anterior part. (After Sayre.)

Ligaments.—These are more contracted than in the normal infant foot. The anterior ligament passing from the tibia to the astragalus and scaphoid are thicker and shorter, and help to fix the bones in the deformed position. Behind the joints there exists between the leg bones and the calcis a capsule which separates into two parts, and an interosseous ligament passing from the tibio-fibular to the postero-tibial surface of the calcis. The calcaneo-scaphoid and calcaneo-cuboid ligaments are shortened on the dorsal, and the external ligaments are elongated, whilst those of the inner and plantar surface are shortened and thickened.

Fasciæ.—The plantar fascia, and especially its inner and middle parts, are not only shortened but thickened,

and this, with the retracted muscles, helps considerably to maintain the deformity. In severe cases there are subcutaneous aponeurotic and fascial bands, which vary in different cases, and must be divided before the deformity can be thoroughly corrected.

Muscles.—At birth these are almost always healthy, but if allowed to remain unused, they soon atrophy, and the muscles of the leg waste, giving rise to the atrophied condition found in neglected cases. After a time the extensor muscles may also become atrophied and degenerated, and

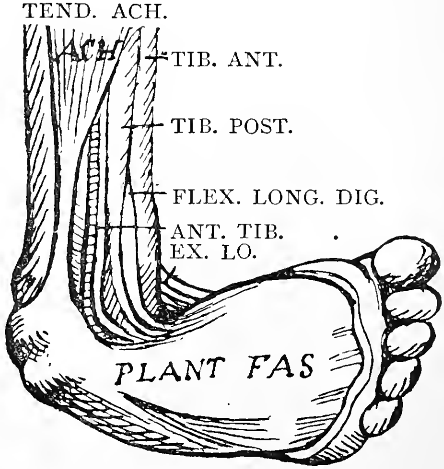


FIG. 65.—Dissection of congenital equino-varus. Left foot.

this change is a fatty and not a fibrous one. Mr. Adams has, however, recorded one case of hypertrophy of the tibial muscles and of the inner head of the gastrocnemius, the outer head being rudimentary. This case is, of course, a rare exception.

Tendons.—The tendons of the tibialis anticus, posticus, flexor longus digitorum, gastrocnemius and soleus (tendo-Achillis) are shortened in equino-varus and altered in direction. The *tibialis anticus* tendon describes a curve

with an internal concavity, and raises the lower part of the deep fascia of the leg and anterior annular ligament as it crosses the tibia at a higher point than normal.

The tendon of the *tibialis posticus* is the highest and most internal, and may be felt behind and above the internal malleolus. In well marked cases it is pulled forwards, but in milder ones it passes onwards in the normal manner to its insertion.

The tendon of the *flexor longus pollicis* is deeply placed beside that of the tibialis posticus, and must be divided in severe cases of the deformity.

The *tendo-Achillis* is shorter and narrower than normal, and is inserted in many cases more to the inner side of the calcanean tuberosity. It may appear displaced outwards through the oblique position of the os calcis.

The tendons of the *peroneus longus* and *brevis* are generally displaced somewhat backwards from their natural groove on the outer surface of the os calcis. The tendon of the *proprius pollicis* can be felt more plainly than is usual along the upper and inner part of the dorsum of the foot, and the tendon of the *extensor communis* may also be felt stretched over the prominent head and neck of the astragalus.

The muscles of the sole of the foot are atrophied, the *abductior pollicis* is generally contracted, and can be felt to the inner side of the inner piece of the plantar fascia, and in severe cases requires division.

The *vessels* and *nerves* are shortened, and follow the displacements of the other parts, but no microscopic nor histological changes have yet been observed in congenital cases. In some cases of congenital equino-varus there are also deformities of the hip or the knee.

Such are the usual changes in congenital equino-varus, but in *neglected cases*, where the sufferer has walked much

on the deformed limb and has been allowed to reach the adult age, further changes, as might be expected, occur, till the bones become more or less atrophied, their tissues less firm, and they are lighter than in health.

The *astragalus* has its inferior surface more concave in an antero-posterior direction and ends in two projections, the one anterior and the other posterior. Its neck is a good deal elongated.

The *os calcis* increases in size in that part which is in front of the astragaloid and above the cuboid articulation. The cuboid facet on its outer side, in articulating with the cuboid, projects on the infero-external border of the foot.

The *scaphoid* is atrophied and compressed in its inner half.

The *cuboid* is partially displaced from the calcaneus, and drawn in and downwards and its external surface has become convex.

The *fifth metatarsal* is carried downwards and articulates behind with the external surface of the cuboid which is now inferior, and this articulation is placed posteriorly to those of the other metatarsals, but in very severe cases the fourth metatarsal joint is also carried a little backwards. This arrangement helps to form *talipes plantaris*, or *cavus*. The ligaments and muscles are much shortened and the latter wasted, and bursæ are developed on the dorsum and outer surface of the foot.

Degrees of Deformity.—In practice we may arrange equino-varus into *three stages*. In the *first*, in which the deformity is slightly pronounced, the foot is easily replaced in its natural position, that is to say, the inversion is corrected and the heel readily brought down. In the *second* stage or degree, but little effect will be made on the deformity. In the *third*, no appreciable effect will result from attempts at manual correction. The deformity is extremely

well marked, and the inner border of the foot forms an acute angle with the leg, and its anterior part is much displaced inwards from its posterior.

The *movements* in equino-varus occur chiefly at the mid-tarsal articulation, and consist of gliding motions, which are so combined that there is, on the one part, a combination of flexion, abduction, and rotation of the sole outwards, and, on the other hand, a combination of abduction, extension and rotation of the sole inwards.

Without explanation this statement would, perhaps, appear difficult of comprehension, but the movements tending to produce rotation outwards of the sole are checked by the contact of the head of the astragalus with the upper and outer part of the os calcis, and also by the ligaments uniting the os calcis posteriorly to the tibia, and by those on the inner side passing from the tibia to the astragalus, and from the latter to the scaphoid. As regards the second series of movements they are reduced almost to *nil*, for the deformity has already placed the foot in the extreme position which these movements produce.

ACQUIRED EQUINO-VARUS.

Causes.—These may be: 1, nervous; 2, traumatic; 3, articular. The *nervous* causes consist of two different kinds, which give rise to what orthopædic surgeons have called the *spastic* or active; and the *paralytic* or passive forms of the deformity. Spinal sclerosis, spasmodic and convulsive affections, inflammation or injuries of the muscles or tendons, may all lead to changes in the form of the foot, and any of these causes may give rise to abnormal muscular contraction and retraction. On the other hand, various diseases and injuries of the cord or nerve trunks leading to paralysis act upon the *abductors*, whereas the

former causes affect the *adductors*. Among the causes leading to nervous incompetence, the commonest are infantile paralysis and progressive fatty atrophy.

The *traumatic* causes are fractures in the neighbourhood of joints, dislocations, sprains, and other injuries leading to synovitis of the tibio-astragaloid or tarsal articulations.

The *articular* causes are due to joint inflammations whether tubercular, syphilitic, rheumatic, or gouty. I have seen instances of all these kinds of acquired varus.

PARALYTIC EQUINO-VARUS.

This is the commonest form of acquired varus and is usually due to a sclerosis, or to a simple atrophy of the anterior spinal columns, and especially to atrophic changes in the cells of the antero-lateral columns and the anterior cornua. The deformity is produced by the healthy muscles predominating over those paralysed, which are the abductors of the foot.

I need not here occupy valuable space by going into the action of the various muscles of the leg and foot, but may refer those interested in the subject to the first volume of my work on "Human Morphology." I need only point out here, that there is usually little difficulty in the *diagnosis*, as the foot is generally cold, bluish, or purple, the leg muscles wasted, and there is a larger subcutaneous deposit of fat than usual, and I have very commonly observed a thickish and longish collar of fatty tissue extending two or three inches along the lower third of the leg. It must be borne in mind that spinal caries causing mono- or paraplegia may produce this deformity, and this should always be inquired into. In paralytic cases the bones will almost always be found wasted, and this will serve to differentiate

such cases from those due to progressive fatty atrophy of the muscles.

Prognosis.—This is far less favourable than in congenital, or even in other cases of acquired varus, and the reason is obvious. In cases of any standing, when all hope of an improvement of the disease of the nervous centres is past, and when electricity fails to produce any hopeful muscular reaction, the case, as regards recovery of nerve power, is next to hopeless, though the deformity may be rectified and kept in good position by apparatus.

Treatment.—The indications in *congenital* equino-varus, as well as in the *acquired* forms, are to correct the deformity and to aid the limb by various manual and surgical means to resume its functions. I need only state with regard to *paralytic* cases, that should massage, electricity, and proper apparatus not correct or improve them, and tenotomy be necessary, extension must be much more gradual than in ordinary cases, for fear of converting the deformity into the opposite one, that is to say, a varus into a valgus, &c. It must also be borne in mind that paralytic limbs must be well preserved from the pressure of splints, and their temperature must also be thoroughly maintained. *Frictions, massage, and electricity*, which are serviceable in some of the ordinary cases, are especially needful in the paralytic forms.

The deformity may be removed in various ways, but it is only in the very slight cases that manipulations, strappings, splints, fixation in plaister of paris, &c., will lead to permanent results. I have tried them all and have been disappointed, so that I may say from an unusually large experience, that in the great majority of cases it is but wasting time to try and do without tenotomy, so I will at once proceed to describe it.

In equino-varus the tendons producing or keeping up

the deformity, and therefore those that require division, have already been given; but I may here re-state that they are the tibialis anticus in front of the malleolus, the tibialis posticus and flexor longus digitorum behind it; these are usually divided in the *first stage* of the operation, and if properly divided the inversion of the anterior part of the foot will usually yield. After about ten days, in infants, but at such time as the inversion is thoroughly corrected, the tendo-Achillis will require division; but if the plantar fascia and abductor pollicis prevent the straightening of the foot, these must be divided and the foot straightened before the tendo-Achillis is cut. If, as is often the case, three operations are necessary, the tendo-Achillis must be the last divided, as it fixes the heel and thus allows the anterior portion of the foot to be unfolded.

Tenotomy.—The patient and surgeon being in convenient positions, an assistant should fix the leg with his left hand, and hold the anterior part of the foot with his right, putting the tendons fairly on the stretch, so that the surgeon may feel them with his left fore and index finger, while he passes the knife beneath them and saws carefully towards the skin. Directly a sharp cracking sound is heard, or when the assistant feels all resistance to be gone, he must immediately relax the foot, the surgeon during the whole operation keeping the knife well under command, so as to prevent its cutting through the skin. The operation being over, a small pad of lint is placed over the puncture, and kept in place by a narrow piece of strapping, the foot is then bandaged in its deformed position to a flexible splint made of zinc, tin, or sheet-iron, well padded, and bent to the shape of the foot.

In the first stage of operative treatment the tibialis posticus and flexor longus digitorum are first divided, and then the tibialis anticus. In dividing the former a sharp

tenotome is passed between the posterior surface of the tibia and the tendons, and the deep fascia well opened. A blunt tenotome is then passed through this opening well behind the tendons, and the edge of the tibia being used as a fulcrum, and the left forefinger and thumb of the surgeon pressing through the skin on the stretched tendons above and below the knife, they will generally rapidly give way if a gentle sawing motion be used. A pad is at once applied and kept in place by the assistant's thumb. To divide the tibialis anticus a sharp tenotome is passed between it and the anterior tibial artery, passing beneath the tendon and cutting towards the skin. A pad is put over this, a bandage is then applied over the foot and pads, and the foot is fastened to the splint as already directed. Care must be taken not to transfix the tendons; if this be done a band will be felt, and it must be divided. The anterior and posterior tibial arteries must not be wounded. Should the case be a *relapsed* one, where previous operations have taken place, and the after-treatment have been improper or unsuccessful, adhesions will have formed between the tendons and their sheaths, and the use of the blunt tenotome in various directions, especially up- and downwards, will be needed. The foot should also be well manipulated immediately after the tenotomy. No especial direction is needed for the division of the tendo-Achillis, except to avoid passing the knife too far in the direction of the posterior tibial artery. For division of the plantar fascia and abductor pollicis, if the surgeon recollect or refresh his anatomy and take care not to pass the knife obliquely down and in towards the sole, he will have no

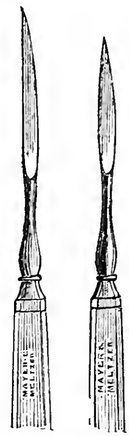


FIG. 66. — Sharp Tenotomes.

great danger or difficulty in successfully dividing these structures.

Accidents, such as wound of the posterior or anterior tibials, or of the plantar arch, inflammation of the sheaths of the tendons, subcutaneous abscesses, &c., are extremely rare, but should they occur they must be treated on ordinary surgical principles. For wound of vessels, a firm graduated pad and compress must be applied, and no attempt to correct the deformity must be made. If trau-

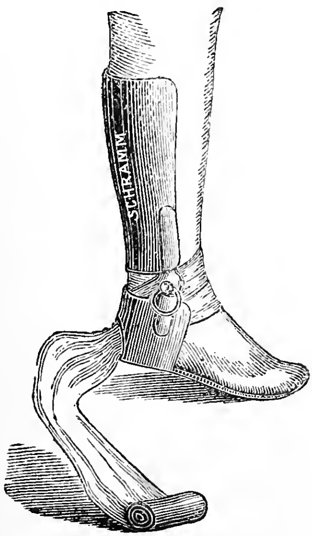


Fig. 67.—Outer view of my universal scarpa.

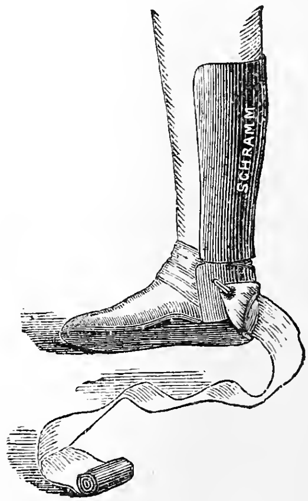


Fig. 68.—Inner view of the same.

matic aneurism result it may be cured by these means, but if hæmorrhage be severe the wounded vessel must be sought and ligatured, except in the case of wound of the plantar arch, and then the posterior tibial, and, if necessary, the anterior also, must be secured. I once saw the tenotome break off against the tibia. This necessitated enlargement of the incision to extract the buried fragment.

When the deformity has been sufficiently corrected by tenotomy and the use of the flexible splints and proper manipulations, a suitable *talipes shoe* must be worn for some time. The form which I have found extremely serviceable in private practice, is figured in the annexed drawing, and that it meets almost every requirement, is sufficiently explained by the fact that its maker has, since I first drew attention to it in the *Medical Times and Gazette*, sold over 500 of them to various hospitals. In

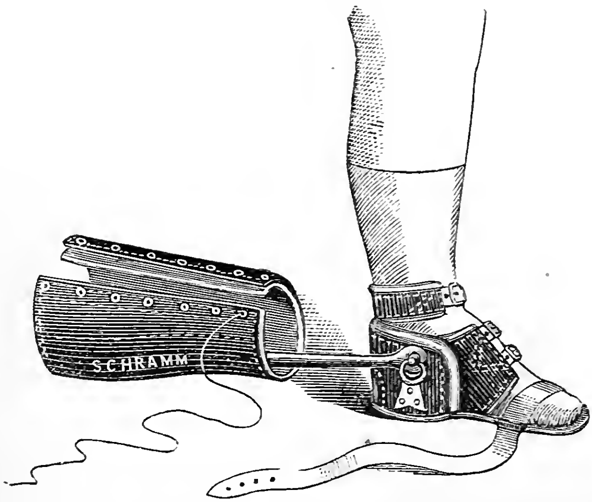


FIG. 69.—Scarpa's shoe for severe cases. New form : The patient can walk in this

severe cases an outside toe-spring is attached, so that the anterior part of the foot can be still further everted. A ball and socket joint or rack-arrangement worked by a key is adapted above the ankle on the outer side. Seeing that it answers for all forms of ordinary talipes I called it the Universal Talipes Shoe.

After-treatment.—I wish it thoroughly to be understood, that though correction by tenotomy and splinting are absolutely essential in the majority of cases, it is in the

subsequent proper adjustment of splints, frictions, manipulations, massage, &c., of the foot and leg, that very much of the success of these cases depend, and I am quite sure that if the tediousness of these cases, which is perhaps augmented by the fact that very few cases come annually under the care of surgeons at general hospitals, were less considered by them, special institutions would see less of

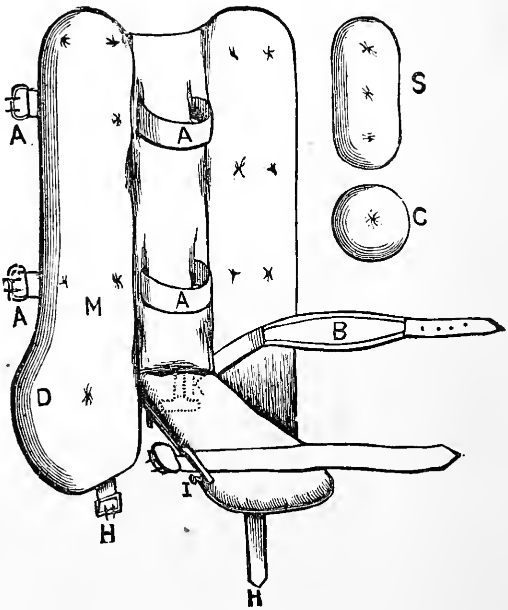


FIG. 70.—Mr. Baker's scarpa for severe cases of equino-varus. A A, Straps to firmly fix the leg; B, Ankle-strap to fix heel; C, Pad to be placed beneath; D, Plate attached to external wing; H, Straps; I, Bar for toe-strap; K, Cog-wheel; S, Large pad to be used inside; M, The outer wing.

relapsed cases. My motto in the treatment of these cases is, that more attention is required *after* the time when the foot is put into a Scarpa than before.

As regards the age at which tenotomy should be done, and with reference to the time necessary to effect a cure in most cases of equino-varus, I would say that as a rule the sooner the operation is undertaken the better, provided the

child or patient be in fairly good health; but there is no objection to allow the child to become two or three months old if necessary, provided extension by splints be carried on during the interval, as this lessens the difficulty of the treatment. At this age the mother, or nurse, has less difficulty in preventing the splint being spoilt by the urine.

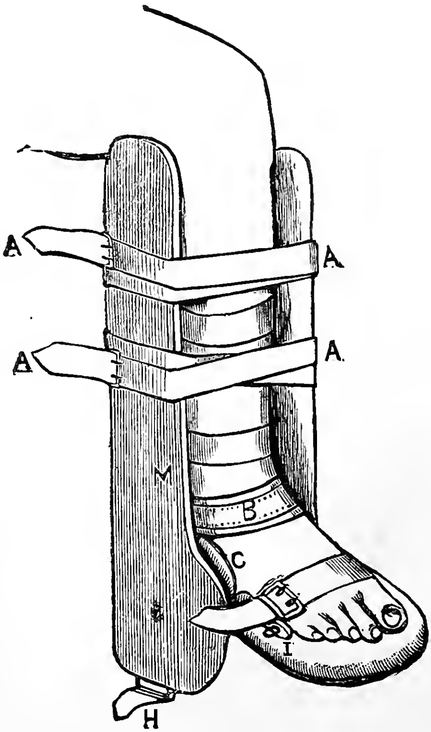


FIG. 71.—The instrument applied.

An ordinary congenital case can be straightened in six weeks, or even less, but it is not safe to lose sight of the patient, and instructions should be given to bring the infant off and on until it is able to walk and be placed in a varus boot or support; and it should then also be watched for months. Any tendency to inversion of the toes should be

corrected by an instrument passing up to the pelvis. A *night instrument* must also be worn for some months, and directions given to the mother or nurse, as to the various

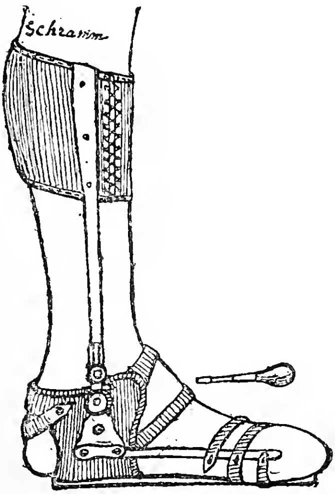


FIG. 72.—Equino - varus shoe for severe cases. The key to work the joint at ankle is shown.

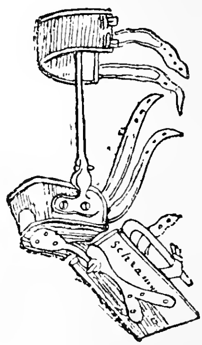


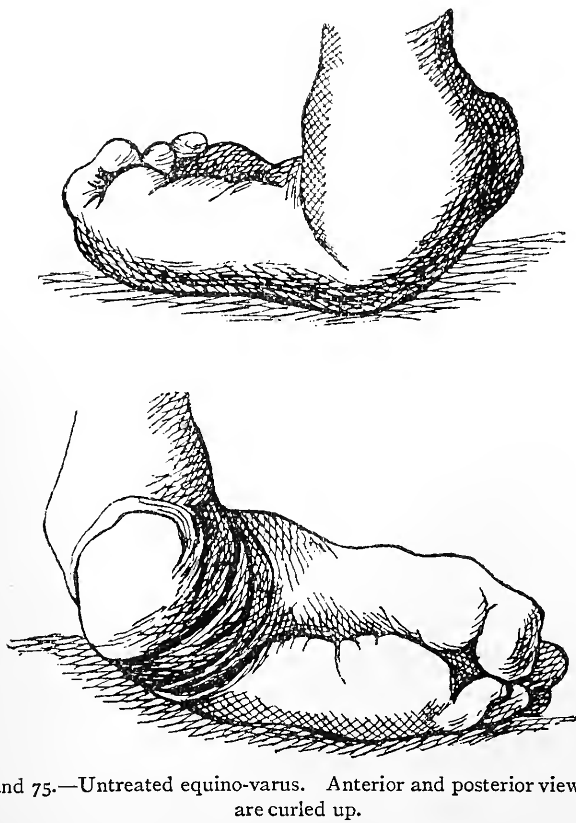
FIG. 73.—Another form of Scarpa with movable sole-plate.

manipulations necessary to keep up the correct position, and to give power and tone to the muscles of the leg and foot.

UNTREATED AND RELAPSED VARUS.

These cases are much more difficult of treatment, because of the deformed condition of the bones and contracted state of the ligaments, and also because of the adhesions which have formed round the sheaths of the tendons. In the severest cases, *anchylosis* of some of the tarsal bones, either fibrous or osseous, may be present. In such cases, I would recommend the following plan of *treatment:* First to divide subcutaneously all tense tendons, ligaments, and fasciæ, and to give a fair trial to the use of

ordinary orthopædic means, such as properly and strongly constructed talipes shoes, and frequent manipulations under anæsthetics. If these fail, forcible correction of the deformity under narcosis should be attempted, and the foot put up in plaister or felt in the improved position.



FIGS. 74 and 75.—Untreated equino-varus. Anterior and posterior views. The toes are curled up.

The splint should be removed in about three weeks, and further powerful manipulations under narcosis should again be resorted to, and the foot again fixed in the splint for a time. If in from two to three months but little benefit arise from this mode of treatment, I should proceed to

open division, or tarsotomy, *i.e.* osteotomy, or osteectomy of the tarsal bones. The preliminary tenotomy is in such cases of great service, and necessitates a less free removal of bone and a smaller wound.

Tarsotomy.—Busch, of Bonn, appears to have been the first to excise a portion of the tarsus in cases of extreme equino-valgus. Solly, inspired by Little, was the first English surgeon that excised the cuboid (1854) and perhaps fragments of neighbouring bones in a young gentleman of twenty-one, affected with severe congenital varus. The result was not so favourable as Solly expected. Mr. Richard Davy, in 1875–6, followed by Mr. Davies-Colley, published cases of excision of portions of the tarsus for equino-varus and equinus. Lund, of Manchester, had, however, excised the astragalus for club-foot, *i.e.* severe equinus, in 1872. Bryant and some other English surgeons have also published cases of this operation. In Germany this method has found favour, and has been variously modified; but in France, Poinsot, of Bordeaux, seems to be the only surgeon who has adopted the plan, though I have heard that in severe cases it has found a few followers in Paris.

Premising that the operation is very rarely indeed necessary in childhood, and reserving it for the neglected or badly relapsed cases of adolescents and adults, I will say a few words as to the operations included under the head of tarsotomy. Tarsotomy comprises several operations, such as excision of a wedge of the tarsus, removal of the astragalus alone, or of the cuboid, with open wound; but I am not aware that *subcutaneous linear tarsotomy* has yet been practised, though I think it would be comparatively easy to avoid damage to tendons, vessels, and nerves, and to cut through the bones with a chisel; but whether an operation not excising a wedge of bone would be successful remains to be proved. Anatomical facts seem to militate

against it if unaccompanied by section of tendons or ligaments.

Poinsot divides this operation into *anterior* and *posterior*. The former attacks the anterior row of tarsal bones, and the latter the posterior. The latter, according to him, consists in excising the astragalus, and has been adopted more especially in severe cases of equinus. The anterior operation he divides into *partial* and *total*. In the former, a single bone is excised, in the latter a large portion of the

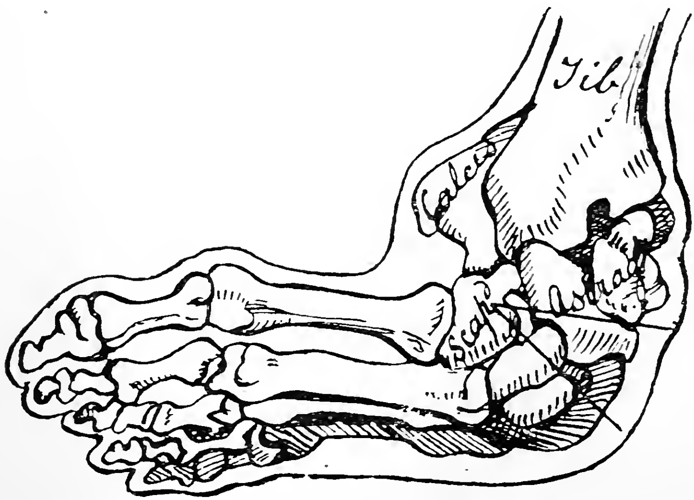


FIG. 76.—Diagram of bony section in tarsotomy for severe equino-varus.

tarsal bones. In both operations, of course, several joints are interfered with; but with care there should be no serious interference with the tendons and their sheaths.

Cuneiform Tarsotomy.—This appears to have been first practised by Otto Weber, of Heidelberg, who re-sected a wedge-shaped portion of the cuboid and calcis. Richard Davy and Davies-Colley performed the operation by first extracting the cuboid, then with the bistoury, saw, and lion-forceps they removed portions of the astragalus, calcis,

scaphoid, and cuneiforms, and the cartilages of the two external metatarsals. The incisions for these operations vary according to their extent, being curvilinear, T-shaped, forming flaps, &c. Bryant made use of the T incision, but his method appears to have the disadvantage of dividing the soft parts on the dorsum of the foot. Rupprecht has advised a method which avoids this inconvenience. He incises the skin from the external malleolus to the base of the fourth metatarsal. The extensor digitorum pedis is partly detached and thrown forwards and inwards with its tendons, and the periosteum is dissected from the tarsal bones to the extent of the cutaneous incision. Two retractors keep the parts separate, and a bistoury passed parallel to the surface of the periosteum, clears as much of the tarsal bones as possible without opening the tibio-astragaloid articulation. Two converging incisions are made through the bones with a chisel, the one parallel with the ankle joint, the other with the metatarso-phalangeal articulations, and the wedge-shaped portion of the tarsus is then removed. All projecting bony spiculæ, or roughnesses, are rounded off with the chisel or forceps, and the foot is placed in a splint in the corrected position.

Poinsot operates thus:—A T-shaped incision, of which the horizontal limb extends from the external malleolus to the head of the fifth metatarsal, and of which the vertical branch passes across the dorsum towards the scaphoid, is made. The tendons are separated from the bones and drawn inwards. The periosteum is then incised in the same direction as the skin, and each of these periosteal flaps are attached to the skin flaps with metallic sutures, which help to keep the wound apart during the rest of the operation. Then he detaches with the chisel (he prefers a saw) an osseous wedge, the lines of which run as in Rupprecht's operation. The base of the wedge will then be external,

and ought generally to measure an inch, and it should be broader at its dorsal than at its plantar surface. He advises that the cuboid should first be excised, and attempts made to rectify the deformity before proceeding to a freer osteotomy.

Meusel has drawn attention to a practical point, which it is necessary to bear in mind, concerning the amount of bone which it is necessary to remove to correct the deformity. Before operating he takes a plaister model of the foot, and by removing portions with a saw from this cast until it can be straightened, he learns how much it is necessary to remove, so as to bring the foot into a proper position. This practice had been previously employed in cases of resections for bony anchylosis of the larger joints. It would appear that the shape of the wedge removed should be such that it should have two faces, one external, and the other towards the dorsum.

Rydygier has recently adopted a plan by which a good position of the foot can be obtained with slight operative injury. His incision begins a little in front of the external malleolus, and passes in a curve with its convexity downwards towards the cuboid. This he makes at once down to the bone as no important parts are injured. He at once obliquely chisels through, from without inwards, the neck of the astragalus, and the anterior processes of the calcis a little further backwards, and by stretching the ligamentous and articular attachments of these bones he is enabled to remove a perpendicular wedged-shaped piece from Chopart's joint. The base of this wedge is above and external. He then removes a horizontal wedge, with its base external from the upper part of the anterior process of the calcis, or from the under part of the astragalus, or from both. The tendo-Achillis is divided before the operation. His paper shows drawings taken from two casts made after the operation, and the result seems good.

E. Hahn has abandoned linear osteotomy of the scaphoid and head of the astragalus on account of its difficulty and tedious subsequent treatment, and prefers extirpation of the astragalus, which he says corrects the supination and plantar flexion in varus. In severe cases with much inversion, a wedged-shaped piece of the anterior processes of the calcis must be removed, and by doing this he succeeded in correcting the greatest deformities. He thinks that Rydygier's method, as well as other wedge-shaped excisions, especially those which open the tibio-astragaloid joint, are apt to be followed by anchylosis of the ankle, thereby doing away with many advantages of the operation.

Mr. McGill of Leeds, at the Copenhagen meeting of the International Medical Congress, described an operation, which is substantially that of Ogston for valgus, applied in the case of varus. He made a longitudinal incision over the cuboid with a branch over the dorsum of the calcaneo-cuboid joint, and removed a more or less extensive bony wedge according to the severity of the case. The cuboid and calcis were then pegged together.

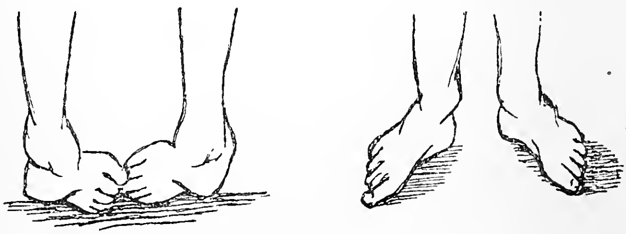
Though for many years I have had opportunities of seeing and treating cases of different kinds of club-foot in all degrees of severity, I have never yet had occasion to perform a tarsal osteectomy, because patient perseverance with ordinary modes has accomplished what was desired. I admit that the treatment of these bad cases is long and tiresome, and taxes the patience of both surgeon and sufferer, but a method I have recently adopted in a severe case of old double equino-varus overcomes these objections. In future I shall not hesitate to operate on any suitable cases in which tenotomy, forcible replacement, massage, &c., have failed, either by tarsotomy or preferentially by that mode to be described presently. I think that tarsotomy, as I have already suggested, may be still further simplified

so that its risks may be considerably minimized, but I should certainly not emulate Mr. Davy in operating on a child sixteen months old, though, as I did not see his case before operation, I can express no opinion about it, except that, though accustomed to see severe cases, I have never seen one in an infant that would not yield to less extreme measures. My experience of osteotomy generally, as well as of many other large surgical proceedings, without the use of antiseptics, would not lead me to hesitate in performing non-antiseptic tarsotomy, though I am not at all prejudiced against Listerian precautions for those who like them, but I see no need to adopt them until better results than my own without, are shown me with them.

Immediate rectification of extreme Equino-Varus by multiple Tenotomy or by open division.—Some time since I operated on a boy aged eleven, the subject of severe double neglected equino-varus by the following plans:—The patient being anæsthetised and Esmarch's bandage applied, the left foot was firmly fixed while its inner border was well stretched by an assistant, and the usual tenotomies before and behind the ankle were done. Then the plantar fascia, abductor pollicis, and all tense fascial bands were divided, and considerable force used to rectify the deformity. The foot was immediately put into plaister of Paris in the corrected position; and when, at the end of three weeks, the plaister was removed, it was found that the inversion, though much improved, was not entirely corrected, I divided other tense bands and the tendo-Achillis. Forcible manipulations brought the foot into good position, though the heel could not be brought completely down. This locking at the ankle is a troublesome feature in bad cases of this deformity, and is often complicated with imperfectly developed

os calcis. The foot was again put up in plaister and fixed to a back splint with rectangular foot-piece.

The right foot was operated on in the following way. After the preliminary tenotomies an incision, two inches long, was made on the inner and lower border of the foot, and joined at each end by others about an inch long across the sole, and a flap of skin and subcutaneous tissue reflected outwards. The abductor pollicis was thus exposed and pulled inwards, and the tarsal ligaments which prevented correction of the deformity were divided. The plantar



FIGS. 77 and 78.—Double congenital neglected equino-varus before and after operation.

fascia was then divided through the opening, and it was found that the inversion could be almost entirely corrected. The tendo-Achillis was divided, but the same difficulty in bringing down the heel was encountered. There was only slight oozing and no vessel had to be tied. The operation was done, as is my wont, without Listerian precautions. The foot was put up in a flexible metal splint, and the wound healed without rise of temperature, though the operation was done without antiseptic precautions. The above figures represent the case before and after operation.

Dr. Phelps of Chateauguay, New York, has operated by open transverse division on five cases, all the patients being under five years old. He divides the tendo-Achillis and then

all structures down to the bones opposite Chopart's joint, and the only parts left uncut are the external plantar artery and nerve. He read a paper on the subject at the Copenhagen meeting of the International Medical Congress.

Dr. W. H. Hingston, of Montreal,* has recently published four cases of severe equino-varus treated by transverse division of all soft parts down to the bones and including the ligaments, and he claims good results. The operation seems to me an unnecessarily severe one, and I should fancy that the large scar resulting from the filling in of a large gaping wound would give trouble in the future. If open division be necessary, the plan I have suggested seems far preferable. A paper was presented to this year's meeting of the British Medical Association at Belfast by Mr. Phelps on "The Treatment of Equino-varus by open Incision," but I have not yet seen it.

Amputation by Syme or Pirogoff's method in the severest paralytic cases, and when patient trial of all other means have failed, and if the patient become a confirmed cripple, may become necessary.

PES VARUS.

This deformity is, in my experience, very rare. I have seen only a very few cases of true varus in which the inner edge of the foot was raised and the sole inverted *without* the heel being drawn up. I am quite at a loss to understand why various English and foreign writers on this subject should describe ordinary congenital equino-varus as varus, seeing that they all acknowledge that the heel is drawn up and that the tendo-Achillis must be divided. If this be true varus, I see no need for their special chapters on equino-varus, which is the same deformity. The *treatment* of

* On certain forms of Club-foot. Montreal. 1884.

severe forms of varus consists in dividing the same tendons as in equino-varus, with the exception of the tendo-Achillis, and the after treatment is conducted on similar principles. This deformity may be *congenital* or *acquired*, but as already said, either form is extremely rare.

Summary of Treatment.—In the milder cases of *equino-varus* in infants, manipulations, elastic traction, forcible correction and the use of splints, plaister of Paris, or other fixed bandage, or Scarpa's shoe, may be efficient; but I have patiently tried them all, and, in the vast majority of cases, have had to resort to tenotomy, so that my opinion is, that these methods usually lead to disappointment and waste valuable time, for—providing the child be from one to two months' old, and in good health—tenotomy, followed by extension in flexible metal splints, and the use of a proper Scarpa, combined with massage twice a day, yield perfect results even in the severest cases. Any form of osteotomy in infants and young children is utterly indefensible and unjustifiable; for even supposing the primary change be in the cartilaginous predecessors of the tarsal bones, these are—at the age alluded to—plastic, and many thousands of cases can be adduced to prove the curability of the deformity without recourse to so unreasonably severe a measure as any form of tarsotomy. Moreover, whether the change in shape and position of the astragalus, &c., be primary, or not, it is abundantly proven to those of large experience in Orthopædic surgery that the tendons are almost always shortened, and that after their division there is usually little difficulty in correcting the malposition.

In neglected or badly relapsed cases in older children, or in adults, severer measures find some justification, but even in these cases there are varying degrees of severity. It has become a very reprehensible and unscientific fashion to lump such cases together, and, from a therapeutic point

of view, to regard tarsotomy as a panacea. I have had the opportunity of seeing a few cases some time after a bone operation had been performed for equino-varus, and the fact that these cases applied for relief, combined with the imperfectly corrected position which the feet were in, and the pain and inconvenience complained of in walking, even with a stick, seem to me sufficient evidence against such operations, except in the very worst cases. I should therefore reserve tarsotomy as a last resource, after having given patient trial to the usually successful orthopædic methods, and as certainly preferable to amputation, which can only be excused in those rare cases where dorsal bursæ have inflamed and ulcerated, and some of the joints and bones are diseased; or in extreme paralytic cases in which the badly nourished skin ulcerates when any pressure is applied, and the patient is practically bedridden.

To the unprejudiced mind the objections to orthopædic plans of treatment are susceptible of the following explanations:—1. They require much patient perseverance on the part of the surgeon and patient. 2. Their tediousness and tiresomeness necessitate too great a call on the hospital time of most general surgeons. 3. The natural desire not to let orthopædic cases pass into specially trained hands, and to cut the gordian knot by a severe operation (thereby using surgical means to which they are accustomed), rather than patiently learn the gentler and—judging from what I have seen—more efficacious means adopted by orthopædists. These are the days of *les folies chirurgicales*, or, as Mr. Erichsen has said, of *surgical audacities*, or, perhaps more correctly, as Mr. Jackson, of Sheffield, truly and non-euphemistically terms many surgical procedures of the present day, of *surgical atrocities;* and no one can deny that tarsal osteotomies in infants and young children richly deserve the last very appropriate name, for the

parents are ignorant, the child helpless, and the surgeon worse than rash who can recommend such a proceeding. Truly, excessive zeal in Listerism will have something to answer for.

Some modern oracles tell us that tenotomy is an unscientific and unjustifiable operation, because other and more important structures than the tendons are involved; yet, these same wiseacres recommend forcible reposition, even to the extent of producing fracture, and they regard tarsotomy as preferable to tenotomy. The logic of such an argument is conspicuous by its absence, for if tenotomy be improper because several other structures besides the tendons are affected, why are only the bones attacked, or, rather, in the case of infants, the flexible cartilages, when several other structures concur in the production of the deformity? But, really, the matter is placed beyond the need of argumentative support or sophistical refutation, for every orthopædic surgeon of experience can adduce hundreds of patients to prove that tenotomy, followed by regular, patient, and attentive subsequent treatment, will so satisfactorily correct the deformity that, in a large number of cases, it is difficult for any but the practised eye to say if club foot ever existed. It is fortunate that the Vienna and Dublin Schools do not agree with these new-fangled views, for the former regards bone operations on children as *needless mutilations;* and Professor Stokes, Mr. Swan, and Mr. Ormsby, of Dublin, rightly hold that in the large majority of cases in children, tenotomy, followed by proper subsequent treatment, suffice to cure the deformity.

CHAPTER XII.

PES EQUINO-VALGUS AND PES VALGUS.

Definition.—This deformity is characterised by a flattening of the tarsal arch, by abduction of the foot, the anterior part of which is turned out; the outer side is raised and the inner border touches the ground. The deformity is the opposite to varus, but almost never attains the same degree of severity, though in some cases the sole is turned back as well as outwards. I will first describe the changes in the *congenital* and subsequently in the *acquired* forms.

Synonyms.—French, *Pied bot valgus;* German, *Plattfuss*.

Varieties.—It may be congenital or acquired, but the former is very rare, and most of the congenital cases which I have seen have been, in reality, equino-valgus, in which the heel has also been drawn up; and if I may judge by the illustrations in the writings of various authors their cases of so-called congenital valgus are nearly all of the same kind. Calcaneo-valgus also occurs as a congenital deformity, and in the acquired forms it is paralytic. It is a great pity for the clear understanding

FIG. 79.—Congenital equino-valgus. Left foot.

of the subject that such loose nomenclature and description has been copied from one book to another. Milder forms of the deformity are known as *flat* or *splay foot* or *spurious valgus*, and these also may be congenital, but are much more commonly acquired. They are best considered under the more correct denomination of *pes planus*, and will be dealt with subsequently.

CONGENITAL EQUINO-VALGUS AND VALGUS.

Degrees.—*Three* degrees have been established, according to the amount of rotation outwards of the anterior part of the foot, and these may be termed *slight*, *moderate*, and *extreme*. In the *first*, the inner portion of the foot is depressed, and the outside raised, the peronei tendons being not tense, and the foot can be brought easily into position. In the *second*, the scaphoid tubercle projects under the skin, the internal malleolus is prominent, and the sole turned outwards. The peronei behind the external malleolus, and the extensor digitorum and peroneus tertius on the dorsum are tense. In the *third* form the patient walks upon the inner malleolus and scaphoid; bursæ form over the points of pressure, and the tendons are very tense. The outer half of the foot is shortened and has a vertical crease opposite the mid-tarsal articulation, and the sole is everted and turned backwards. If untreated, congenital equino-valgus causes greater difficulty and more pain to the child in walking than does varus, and if the child be a heavy one, the deformity will rapidly increase.

Pathological Anatomy.—Adams has shown that in this deformity the changes are less, though carried to a more advanced stage, than in congenital varus, *i.e.*, equino-varus. Of the *bones* the astragalus is somewhat pushed forwards and downwards. The *scaphoid* is carried out and

up and at the same time rotated on its antero-posterior axis, so that its inner part is depressed and the outer raised, therefore the upper part of the astragaloid head does not articulate with it. The *cuboid* is also drawn up and its outer border raised.

The *os calcis* is rotated on an antero-posterior axis, so that the concavity formed by its inferior surface is directed downwards instead of inwards, and its tuberosity looks outwards and is also raised. There is also a rotation of this bone on a vertical axis, so that its anterior part is carried in, and its posterior outwards. In severe cases its outer surface articulates with the external malleolus. The metatarsal bones and phalanges are carried up and outwards. As a result of these bony changes the plantar arch is rendered convex, and *three* projections are readily felt on the inner side of the foot. These are, 1. The upper part of the head of the astragalus. 2. The inner border and tubercle of the scaphoid. 3. The first cuneiform. Between these are two depressions due to stretching of the ligaments and separation of the bones. In less severe cases the cuneiform prominence is not noticeable.

Ligaments.—Those on the internal and lower side of the foot are stretched, whereas those on the upper surface are retracted. The calcaneo-scaphoid ligament is also much stretched.

Muscles.—The muscles that are shortened are the three peronei and the extensor longus digitorum, the tendc-Achillis participating in equino-valgus. In severe cases the abductor minimi digiti and extensor pollicis have been found contracted. Some writers have raised a doubt as to the peroneus longus being contracted in congenital valgus, because the first effect of its contraction is to produce a hollow sole, *i.e.*, *pes plantaris* or *cavus* which is never found in congenital valgus. I have recently operated on a

girl aged three at the Royal Orthopædic Hospital, the subject of congenital valgus of the pure form, and on the left foot the peronei and extensor longus were much contracted, but the peronei were less so on the right foot. The illustration in the section on congenital valgus shows the deformity, which, in foreshortening, looks as if the heels were drawn up.

The tendons are not much altered in position in ordinary cases, and the *vessels* and *nerves* present no important alteration.

PES VALGUS ACQUISITUS.

Definition.—This deformity is characterized by depression of the arch of the foot, so that the inner side of the sole touches the ground. In the severer forms the sole is everted and may be turned backwards.

Causes, Varieties, and Degrees.—This distortion, which consists in flattening of the plantar arch, especially on its inner side, may be due to *statical*, *nervous*, *traumatic*, *atonic*, *rachitic*, and *articular* causes. The statical, rachitic, and paralytic forms are, in my experience, the commonest. By *statical* I mean that there has been an altered axis of bodily pressure towards the inner side of the foot, and if the bones, muscles, or ligaments be weak, the arch will sooner or later yield. The *nervous* forms include the *paralytic* and *spasmodic* or *intermittent* varieties. The paralytic is common while the spasmodic is rare. The *traumatic* forms may be due to fracture or dislocation of the tibia, or injury of the tarsal, or metatarsal joints, or to cicatrices of severe injuries and burns. Disease of the ankle or neighbouring joints, and disease due to tubercle, gout, rheumatism, or syphilis; or secondary to injury of these parts, are included under the *articular* causes. The statical and

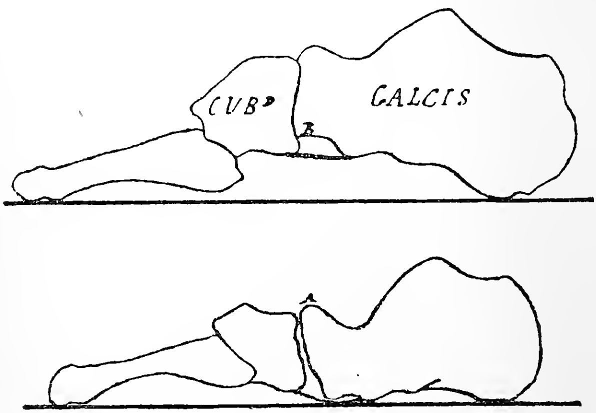
atonic forms, the latter due to laxity of muscles and ligaments, are common in quickly growing adolescents, especially in those whose bodies are unduly heavy, and I have frequently seen it as a result of corpulency, and due, doubtless, to the great body weight. Acquired valgus may also be *intermittent* or *permanent.* It may be secondary to knock-knee, or the latter may follow on it. Long standing, or the carrying of heavy weights, or sudden great exertion, may cause it. The mechanism of the plantar arches and of the production of valgus and planus, will be found in the chapter on pes planus.

Degrees.—It is difficult to get exact accounts from patients, but from many inquiries, and from having had the opportunity of seeing this affection in various forms and stages, I think *three* degrees of the acquired valgus exist, viz., *ordinary* or *slight flat foot*, the *medium*, and the *severe ;* and that they are primarily due to abnormal direction of the pressure-weight of the body towards the inner side of the foot. This abnormal pressure is most often due to imperfect action of the peroneus longus, and this action may be *intermittent* or *permanent.*

Pathological Anatomy.—Except in rachitic or old paralytic and rheumatic cases the bones are not much altered in themselves but only in their relative position. The *astragalus* is rotated and somewhat displaced downwards, and the *scaphoid* and *inner cuneiform* move in the same direction. In the paralytic forms the muscles, and especially the tibialis anticus, are degenerated. The instep is flattened, the *inner malleolus* is more prominent and nearer the ground, and in severe cases there is a space between it and the inner side of the astragalus. The astragalus and scaphoid project upon the inner side of the foot, and in bad cases the scaphoid and inner cuneiform bear the pressure of the foot, and bursæ become developed.

The *muscles* and *ligaments* upon the inner side of the joint are stretched, while those on the outer become secondarily contracted. In cases of long standing ankylosis may occur.

Various theories as to the mode of production of flat foot have been advanced. Stromeyer* thought that atony of the plantar fascia and of the tarsal ligaments was its cause. Henke† says that muscular insufficiency and body-



FIGS. 80 and 81.—Diagrams of the external aspect of a normal, and severe valgoid, foot-arch. B in the upper figure shows the highest point of the arch with the calcaneo-cuboid ligament beneath it. A in the lower figure shows the prominence of the calcis and the separation between it and the cuboid. (After Lorenz.)

pressure are the factors in the production of valgus which is a *pes pronatus*, *flexus*, and *reflexus*, and that it consists essentially in a changed position of the joints and consequent alterations in the shape of the bones.‡ Hueter regarded it as a statical distortion produced by the body weight, causing defective development of the bones, but

* Beiträge zur operativen Orthopädik, 1838.

† Zeitschft. für rationelle Medicin, 3rd series, Vol. 5, 1859.

‡ Kritisches über Klump-und Plattfuss. Prager Viertjahrschft, B. 1. 1875.

Volkmann* and Reismann have shown that the femoral neck rises and the foot-arch forms in spite of this, and that it is therefore very improbable that valgus should be produced by it.

Reismann† attributes valgus to contraction, first of the extensors, and then of the pronators, producing a pes pronatus and flexus, and states that a sinking of the arch is impossible on account of the construction of the calcaneo-cuboid joint; but Lorenz‡ in his excellent essay, and also Volkmann, have shown the fallacy of this view which is unsupported by any pathological examinations. Lorenz supports Henke's view, but regards sinking of the external arch from pressure as the primary change, and the pronation and abduction of the foot as later secondary results, produced by a sliding away of the inner from the outer arch. In fact the arches tend to become placed side by side instead of the inner resting, as in the normal foot, on the outer.

Hermann von Meyer § says, that this form of flat foot does not depend upon a vertical depression of the plantar arch, but that the *fundamental* phenomenon is a valgoid position of the remaining portion of the foot, especially of the calcaneus to the astragalus, and that associated with this fundamental phenomenon is a striking *secondary* one which consists in a bending of the anterior part of the foot up and out against its hinder part. The

* Ueber den Plattfuss Kleiner Kinder, Central-Blatt für Chirurgie, 1881.

† Der erworbene Plattfuss. Langenbeck's Archiv, B. 2, Heft 3, 1869; and Kritische Bemerkungen der Lehre von der Entstehung des erworbenen schmerzhaften Plattfusses. Same Archiv, B. 28, H. 4, 1883.

‡ Die Lehre vom erworbenen Plattfusse, 1883.

§ Ursache und Mechanismus der Enstehung des erworbenen Plattfusses, 1883.

cause of these appearances is not to be sought in the weakening of the plantar ligaments, but the originating source for the transformation of a normal into a flat foot

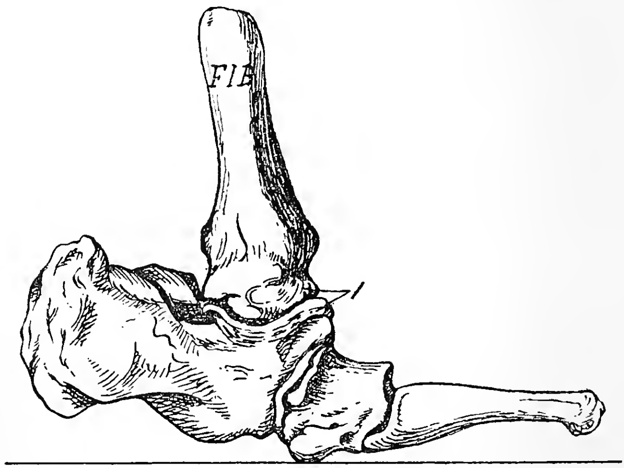


FIG. 82.—Showing the skeleton of a convex or canoe-shaped sole of an extreme valgus. (After Lorenz.) 1. A new joint between the fibula and calcis. The cuboid touches the ground but the calcis and metatarsal are raised.

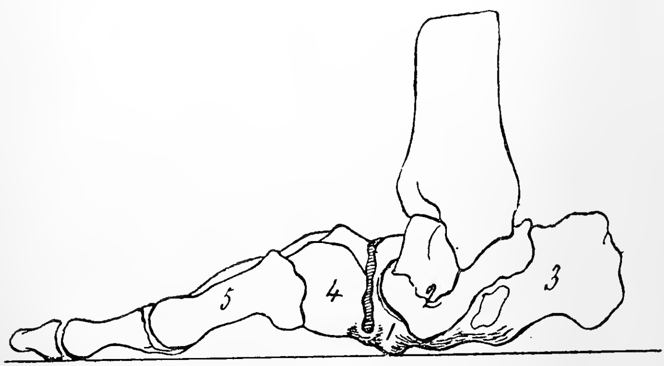


FIG. 83—Inner view of the bones of a severe valgus. 1, Scaphoid tubercle; 2, Astragalus; 3, Calcis; 4, Cuboid; 5, Inner metatarsal which appears shortened. The plantar calcaneo-scaphoid ligament is stretched. (After Lorenz.)

resides in a rotation of the astragalus inwards, which is, of course, assisted by the pressure of the ground in standing

and walking. This valgoid condition, which next affects the calcis, is due to the rotation altering the position of the line of gravity inwards from the line of the great toe, and the bending is to be attributed to the raising of the posterior process of the os calcis up and out, through the traction which the rotation of the astragalus exercises on the calcaneo-fibular ligaments. The changes in the relative positions of the tarsal bones are not caused and gradually increased through weakening of the ligaments, but through pressure-atrophy of the bones; and the two

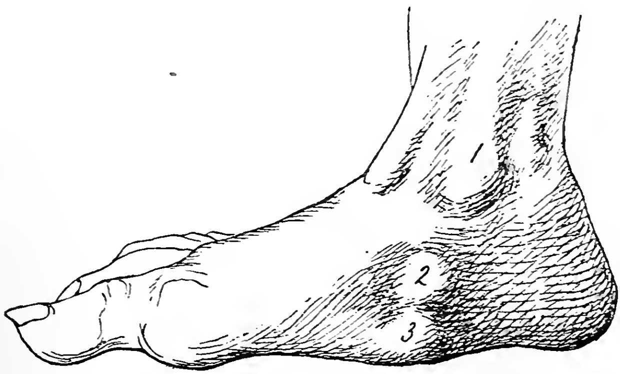


FIG. 84.—Inner view of severe right valgus. 1, Inner malleolus; 2, Inner part of head of astragalus; 3, Scaphoid tubercle.

following false joints, which are found in the highest degrees of the deformity, are caused by the two elements producing flat foot. The new or false joint between the calcis and fibula is caused by the valgoid position of the latter, and the joint between the scaphoid and upper surface of the neck of the astragalus is due to a bending or flattening, and ultimate convexity, of the sole.

Paralytic Valgus.—The *paralytic* varieties are of practical importance. They may be produced in two ways 1. By paralysis of the foot adductors. 2. Through paralysis of the peroneus longus. In the former, the tibialis

anticus and posticus, and especially the latter, are the muscles chiefly affected, and the abductors of the foot, the peronei, are then free to act and place the foot in abduction; and the peroneus longus being no longer counter-balanced by the tibialis anticus, increases the concavity of the plantar arch, so that a *valgo-cavus* results. In paralysis of the peroneus longus a form of flat foot termed *painful valgus* results, and a peculiar condition of it in a state of abduction, combined with effacement of the plantar arch, and tarsalgia, results. Guérin thought this

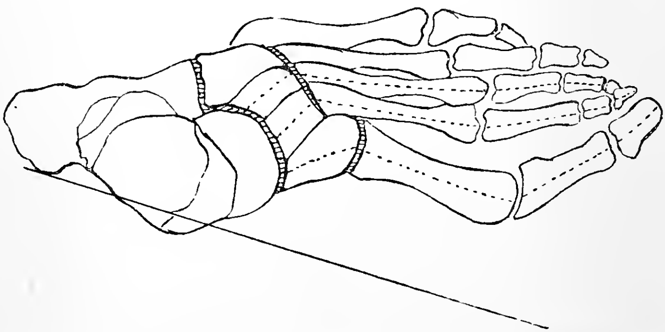


Fig. 85.—Diagram of bad valgus from above, showing the altered axes of the tarsals, metatarsals and phalanges, and the projection of the head of the astragalus.

variety was due to relaxation of the tarsal ligaments, which caused pain and reflex contraction of the peronei and extensor communis, and advised tenotomy. Duchenne showed by faradization that this affection was due to paralysis of the peroneus longus, and that if the peroneus brevis and tertius and extensor communis be contracted, this is purely reflex. Seeing that the first effect of contraction of the peroneus longus is to increase the convexity of the arch, it seems difficult to believe that this form of valgus is due solely to the contraction of that muscle.

Symptoms and External Appearances.—In most

cases of this deformity the patient applies because of pain and difficulty in walking, and inability to stand or go any distance. There will be pain towards the inner side and sole of the foot, and in cases of any standing the muscles on the outer side, the peronei and extensor longus digitorum, will be found prominent and secondarily contracted. This phenomenon is a reflex one, and such cases must not be mistaken for primary spasmodic or spastic valgus, which is a very rare affection. On endeavouring to rectify the foot with the hands, the patient will complain of pain, and refer it to the region of the muscles just mentioned. The impression of the sole in such cases is represented in a subsequent figure. The walk is characteristic, the subject coming down on the inner part of the foot, with, in severe cases, the knees in a flexed valgoid position. There is always a halting or lameness in the gait.

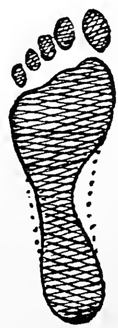


FIG. 86.—Impression of a normal sole. The dotted line shows the outer and inner borders of the foot.

In *ordinary* flat foot the plantar arch is considerably depressed, and the malleoli are sunken and prominent, especially the inner. The foot is prone to fœtid perspiration, and the skin on its inner side is thin, but on the outer thickened. Pains along the course of the peronei and about the external malleolus, and across the instep, are complained of, and often produced on pressure. If pressure be made on the plantar surface or on the metatarso-phalangeal articulation of the great toe while the foot is extended, and the patient be willing to resist this pressure, he will be able to do so. If the patient be sitting or lying with the foot extended, it will have a tendency towards varus. This is caused by the tibialis posticus, gastrocnemius, and soleus, which, being extensors and adductors, are

incapable of producing rectilinear extension on account of paresis of the peroneus longus. When the patient is standing, his foot flattens out on the ground, the instep has almost disappeared, and he cannot raise himself on his toes. In going up stairs the whole of the foot is placed upon each step, instead of the anterior portion, as with normal feet; and in walking, the foot does not touch the ground from heel to toes, but by the whole sole.

In the *second* or *medium* degree of the deformity the pains increase, and painful points in the region of the peronei, at the neck of the astragalus, and near the internal malleolus, and at the base of the first and fifth metatarsals, may exist, but ordinarily these are only found in the third degree, the commonest seat of pain being that to the inner and lower side of the astragalus.

In the *third* degree pain is much increased. On walking there is a feeling of heaviness and creeping sensations in the sole, which are due to compression of the plantar nerves. The painful points are more numerous and the deformity is permanent. The sub-astragaloid painful spot is a little in front of the external malleolus, on a level with the calcaneo-astragaloid articulation, and is due to pressure between the articular surfaces and bruising of the interosseous ligaments. The pain about the head and neck of the astragalus is due to stretching of the astragalo-scaphoid ligament, and to the depression and rotation of the astragalus. The peroneal pain is along the course of the peroneus longus. The pain at the base of the first metatarsal is due to the action of the tibialis anticus, unbalanced by that of the peroneus longus, and this abnormal action tends to raise the first cuneiform and metatarsal bones, producing stretching and frictions which cause pain. There is another painful spot at the outer side of the joint in the neighbourhood of the calcaneo-cuboid joint, and

this is produced by the stretching of the calcaneo-cuboid ligament through effacement of the plantar arch.

This form of flat foot, if not remedied, passes on to abduction of the anterior portion of the foot and eversion of the sole, and this is due to impotence of the peroneus longus, which can no longer keep the inner part of the sole applied to the ground, so that an external rotation occurs at the mid-tarsal joint, and this is increased by the reflex contraction of the peroneus brevis, tertius, and extensor communis. In the second degree the symptoms may intermit, *i.e.*, when resting or simply standing, the pain and the deformity diminish, and after long standing and walking reappear. If the patient be told to stand, his foot will be observed to be simply flat; but long standing or walking bring on the pains, and the foot is in marked valgus, and if any great exercise (which such cases can rarely take) have been indulged in the pain is much increased, and I have known cases which ended in tarsal synovitis. In the third and *permanent* form the deformity remains whether the patient be resting or not, and this is due to the permanent contraction, and, in old cases, retraction of the peroneus brevis, tertius, and extensor communis digitorum.

There can be little doubt that, in time, physiology and pathology may sufficiently explain a large part of this class of cases by referring it to temporary, and then final paralysis of the peroneus longus, whether primary or secondary. The action of this muscle is to depress the internal border of the anterior part of the foot, to increase the concavity of the plantar arch, to keep the first metatarsal depressed during extension of the foot, and also to raise its external border, and these are the very actions which are disturbed in cases of severe valgus.

There is a symptom to which I will draw attention, having noticed it in many instances of severe acquired

valgus, and this is a pain and stiffness at the metatarso-phalangeal joint of the great toe, and flattening of the ball of the toe. Sometimes this is the first thing noticed by the patient, and the tarsal pains appear subsequently. Nearly all cases of acquired valgus occur in those having long feet.

Mode of Production.—From a consideration of the foregoing facts it would appear that acquired valgus originates in the following way:—First, some pressure, abnormal either in direction or extent, causes a stretching and exhaustion of the muscles, ligaments, fascia, and tendons of the sole; then the outer arch becomes depressed and the inner glides down and in from it, tending to become parallel with it. The astragalus is pushed down, stretching the internal lateral and tibio-astragaloid ligaments, and carrying with it the scaphoid, cuneiforms, and inner metatarsals; the astragalo-scaphoid joint becomes loosened and gaping at its inner border, and the inner part of the articular facet of the astragalus is no longer in contact with the scaphoid. Its cartilage becomes absorbed, and the inner portion of its head projects internally, and forms an obvious prominence. The ligaments on the plantar aspect of the joints become stretched, and the bones parted from each other in this situation, while at the dorsal aspect they are pressed together, and impeded growth or absorption results. In the severest cases, not only does the head of the astragalus touch the ground, but the sole divides at the mid-tarsal joint into an anterior and posterior part, the former being the walking sole, while the latter, consisting of the os calcis and the astragalus, is drawn up posteriorly, so that the calcanean tuberosity is raised an inch from the ground, and this part of the sole does not touch the soil. Soon the bones become permanently fixed in this position, and the canoe-shaped foot is produced. In the earlier stages, the deformity may disappear after resting,

or on raising the foot, but later on anchylosis results, and the malady becomes permanent.

Diagnosis.—This consists in ætiological differentiation, and the history of the case and symptoms are generally enough for this purpose. In slight degrees, and especially if occurring early in life, it may be confounded with the congenital form of valgus. I use the term *form* advisedly, to differentiate a tendency to slight flat foot at birth, from the rare forms of congenital pes valgus proper. In congenital valgus the deformity is almost always double and the peroneus longus has a normal faradaic reaction. Acquired flat foot, on the other hand, may be single or double. *Painful flat foot* may be confounded with *tarsalgia*, due to joint disease, and in these cases the deformity is secondary. I have recently operated at the London Hospital on a tall young woman of twenty, with badly marked double valgus. She had most of the painful spots referred to, the feet sweated, and there was a doughy fulness in the position of the astragalo-scaphoid and scapho-cuneiform joints, which I regarded as secondary. Tenotomy of the peronei and extensor longus digitorum was done, and she was kept in bed for one month, when she was allowed to walk the ward in her boots and supports. On the second day she complained of great pain, and there was a good deal of doughy swelling and tenderness over these joints, and I began to think that hers was an instance of valgus and reflex muscular contraction secondary to joint disease; but two days' rest, with evaporating lotions, completely cured her, and she walked well, leaving the hospital in a few days. In older people the dry forms of arthritis may also give rise to diagnostic difficulty. Gosselin records a case of tarsalgia in which post-mortem examination showed erosions, and disappearance of the cartilages, of the calcaneo-cuboid and astragalo-scaphoid joints, and attributes

the tarsalgia of adults to these changes; but the severe forms of valgus, long continued, will lead to joint deformity, and may cause cartilaginous erosion. It should be recollected that incipient stages of tarsal and metatarsal bone and joint disease, and of perforating ulcer, may give rise to diagnostic difficulty, as the foot is more or less flattened in such cases, and also that neurarthropathies, such as Charcot's joint disease, may also simulate the symptoms of valgus. The pathology and differential diagnostic signs of these are still very doubtful. It must be borne in mind that after resting, or even in raising the foot from the ground, the flattened condition may disappear, except in the worst cases.

Prognosis.—If valgus due to paresis of the peroneus longus be seen in an early stage it is easy to cure, but in the later stages it is less easy, unless sufficient power be left in the muscle to completely recover its functions. If joint mischief have arisen the prognosis is, of course, more serious, and this may occur in neglected cases. In ordinary cases of acquired valgus tenotomy, massage, and proper apparatus will correct the deformity; but if anchylosis have occurred, and pain and difficult progression exist, tarsotomy may prove successful.

VALGUS ANKLE.

This condition, known popularly as *weak ankles*, is not alluded to in surgical works, and consists in a laxity of the internal lateral ligament and consequent bulging of the internal malleolus, with a tendency to the formation of valgus. It may exist quite independently of the latter, and is not uncommon in infantile paralysis of the lower limbs, and in cases where the arch of the foot is increased and the plantar fascia tense. In some cases the internal

malleolus is overgrown laterally, and a condition somewhat similar to the projection of the internal condyle in atonic genu valgum results. I have seen small bony spicules in the neighbourhood of the inner ankle, reminding me of those met with in the tibia, and occasionally on the internal tuberosity of the femur. If unchecked, some of these cases may pass, mechanically, into valgus.

Symptoms.—The deformity is obvious, and occurs usually in quickly growing children or adolescents with lax fibre. The ankles knock together in walking, and this, with the wearing away of the boots where the ankles rub each other in walking, are noticed and complained of. The patient is very apt to tread or slip over to the inner side of the foot, and sometimes this gives rise to severe sprains and, in two or three cases I know of, a Pott's fracture was thus produced.

Treatment.—This consists in giving firm support to the joint on its inner side by good elastic anklets, and by the wearing of a boot and support with a properly adjusted T-strap. All prolonged efforts of standing and walking must be avoided, and the joint strengthened by massage, frictions, &c.

CONGENITAL VALGUS.

In this deformity the sole of the foot is flattened, the inner margin touches the ground, the outer being raised, and the anterior portion of the foot is everted. In severe cases the sole is turned out and back. Pure congenital valgus is, as previously stated, rare in my experience, but equino-valgus is the commonest form of the congenital deformity, and calcaneo-valgus is commoner than pure valgus. Bouvier divides congenital valgus into two kinds: those in which the foot is simply flattened out, and those in

which there is a turning outwards of the sole. The former are not painful, but the latter may be. The first form is really *pes planus*.

Morbid Anatomy.—There have been very few examinations of the feet of infants affected with this distortion. Rignetta dissected one, and found that the posterior tuberosity of the *calcis* was very short, thin, and thrown outwards, as was the tendo-Achillis. The body of the calcaneus was thinner and shorter than natural, and its superior articular facets less marked. Its anterior tube-

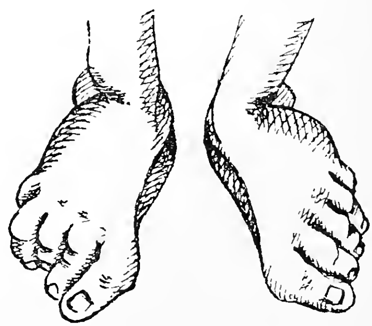


Fig. 87.—Double congenital valgus from a girl aged two and a-half. In foreshortening the heels appear drawn up. From a case of mine at the Royal Orthopædic Hospital.

rosity was directed inwards and participated in the general atrophy of the bone. The *scaphoid* and *cuboid* were rotated inwards on an antero-posterior axis. The fifth metatarsal bone was shorter and thicker than natural, and the tarsal ligaments were lax, permitting greater motion. Adams observed that the *astragalus* was tilted down and forwards, and that the rotation of the scaphoid left the upper part of the head of the astragalus projecting. He also says that the cuboid is slightly rotated outwards and not inwards. Lacour examined the foot of an adolescent born with this deformity, and found that the head of the

astragalus was depressed on its outer side, so that the direction of the astragalo-scaphoid joint was changed. In these cases the malleoli are depressed.

Symptoms.—If the deformity have been uncorrected, when the child begins to walk, and after it has done so for a short time, it will show disinclination to do so, and will cry if it be put upon its feet on account of the pains produced in the plantar region; but some cases growing into childhood walk fairly well. If handled, the motions of the foot are found to be impeded, and the patients cannot produce much voluntary motion in the tarsal joints, and the majority cannot raise themselves upon the feet. Faradization of the peroneus longus will result in contraction in some cases, but not in others.

The pain experienced in this, and especially in the neglected forms of the malady, may be due to paresis of the peroneus longus, or to relaxation of the ligaments, or to altered direction of the bones causing abnormal pressure in the joints, and on the skin of the inner side of the foot, which gives rise to reflex cramps.

In bad cases the foot is curved up and back at the transverse tarsal joint, the plantar ligaments are much stretched and the dorsal contracted, the calcaneo-scaphoid being often much relaxed. The retracted muscles are the extensor longus digitorum, the tendo-Achillis, and the peronei, the longus being excepted in some forms. The extensor proprius pollicis, digitorum, and minimi digiti may also be contracted.

Treatment.—Rest, if it can be obtained, should be strictly enjoined, and if the peroneus longus be weakened electricity must be had recourse to. Frictions and massage of the peroneal region are also serviceable, and electricity and subcutaneous injection of strychnine and of eserine have been recommended in *paralytic* or *paretic* cases, but

it is needless to say that in *congenital* cases this treatment must not be adopted. In such cases, if the deformity be slight, manipulations and bandaging to a splint on the inner side of the leg, so as to turn the sole towards it, will sometimes, if persevered in, result in cure; but in the majority of cases tenotomy must be performed, and first the peronei and then the extensor longus digitorum and peroneus tertius should be divided, and when the eversion and external rotation are corrected, the tendo-Achillis will need division. This is in the ordinary form, *i.e.*, equino-valgus, but if there be no equinus, of course there will be no need for tenotomy of the tendo-Achillis.

The treatment of *acquired* valgus varies with its degree and cause. In the milder forms, where there is no great tarsalgia or contraction of tendons, the wearing of a properly-adjusted sole-plate during the day, and massage of the foot night and morning, is of great service. In some cases forcible rectification under an anæsthetic, and the immediate application of a plaister-of-Paris bandage is of service. In *statical* instances, rest must be enjoined. In *articular* cases, rest, and Scott's dressing, strapping, and bandaging are indicated. In infants and young children, Mr. Churchill's plaister-of-Paris bandage is serviceable, and is described in the *Medical Times* for July 19, 1884. In *rachitic* valgus the arch and instep of the foot must be supported; any deformities in the limbs throwing the line of gravity inwards must be corrected, and any secondarily retracted tendons tenotomized. In the *paralytic* forms, as a rule, no tendons, except the tendo-Achillis, need division, and the same care in subsequently stretching this tendon must be observed as in cases of paralytic varus. It has already been mentioned that genu valgum may be the result of talipes valgus and *vice versâ*. Relapse is rare in properly treated cases.

In more aggravated cases the peronei and extensor longus

digitorum are, or become, prominent on attempting manually to correct the deformity, and pain is produced. These tendons must be divided, and subsequently a valgus boot and support, or a Nyrop's boot, must be worn for a time. The boot recently described by Mr. Walsham in the *Lancet* is Nyrop's boot, as the adjoining figure will show; but, doubtless, it was unknown to him. I use a boot the sock or inner sole of which is hollowed out on the outer side, but the inner side of it, and of the external sole, is thick, and the latter is bevelled off to the outer side of the foot. A valgus boot and support with a strong T-strap is very useful without, or after operation, if this be necessary. Frictions, massage, and moulding of the foot are also needed two or three times daily.

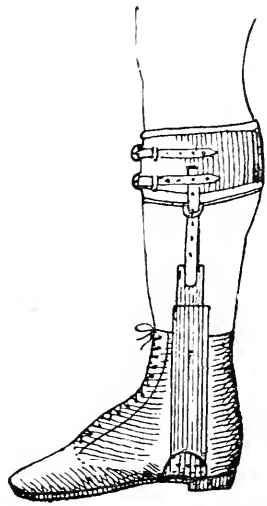


FIG. 88.—Nyrop's valgus boot.

Tenotomy.—To divide the peronei the tenotome must be passed between these muscles and the edge of the fibula; in adults, about an inch and a half above the external malleolus; in infants, about half an inch above it, and the division made towards the skin. To divide the extensor longus and peroneus tertius, the tenotome must be inserted at the inner border of the extensor, being careful not to wound the anterior tibial artery and nerve. Should it, in any case, be necessary to divide the tibialis anticus and extensor pollicis, the same puncture will suffice if the knife be turned inwards between the anterior tibial vessels and the skin. After three or four days the foot must be gradually put into a correct position, and, unless the case be a severe one, a Scarpa will not be necessary;

but, if so, the universal Scarpa, already described, will be found a serviceable instrument. The patient may then wear a boot and support with outside iron, the boot having a leather T-strap. Inside the boot there will be a steel valgus sole-plate, or wedge-shaped pads covered with wash-leather. In some cases, where pressure cannot be borne on the sole of the foot, if the heel of the boot be bevelled and carried forward on the inner side, the purpose may often be answered. It is not often that an instrument passing up to the pelvis is necessary in these cases, but the patient, or the parents, should be informed that massage and manipulations of the foot in the right direction are necessary for some time.

In the *worst cases*, where the foot is rigid and the sole convex, Dr. Alexander Ogston, of Aberdeen, has carried out an operation, the results of which Mr. W. Adams spoke well of at a recent meeting of the Medical Society; but the report of the meeting does not say if he saw any of the cases before operation, so as to be able to express an opinion as to its necessity. Mr. Ogston's paper is in the *Lancet* for January 26, 1884. Mr. Golding Bird has performed a somewhat similar operation, and has published a paper on the subject in the Guy's Hospital Reports for 1883.

Ogston's Operation.—An incision an inch and a quarter long is made along the inner border of the foot, its middle corresponding to the astragalo-scaphoid joint, which is, in these cases, about half an inch nearer the toes than in a normal foot. In severe cases the incision may be curved. All structures down to the bone are divided by this first cut. The inner part of the head of the astragalus is generally visible through the incised capsular ligament, and the wound being held apart by aneurism needles, free access to the joint is obtained by separating the attach-

ments of the ligaments for half an inch anteriorly and posteriorly. The ligament is then seized with forceps and detached from its connections to the scaphoid, but its attachments to the periosteum must be preserved by cutting with the knife on the flat, the edge being towards the toes. A stout chisel, half an inch broad, and bevelled on one side, is applied to the head of the astragalus with the bevelled side *away* from it, and the cartilage, *plus* a thin layer of subcartilaginous cancellous bone, removed. The chisel is then used to the scaphoid, the bevelled side *towards* it, as the surface to be denuded is concave, and by repeated shavings, the denudation proceeds to the required extent. In old or severe cases, the bony projecting growth on the lower surface of the astragaloid facet must be removed. The next step is to restore the foot to its corrected position, and while an assistant maintains this, to apply a drill to the upper and inner side of the scaphoid and direct it to the centre of the caput tali, and a hole an inch and a quarter long is made through both bones. An ivory peg is then driven home and the projecting part removed by bone forceps on a level with the scaphoid. A second perforation, parallel with the first and half an inch from it, is then made through the two bones and another peg fixed in. The wound is then closed and the foot put up in Paris plaister. Ogston uses strict antisepticism. The patients suffer sharp pain for twenty-four hours. They must be kept in bed for two or three months and may then walk. He has operated seventeen times on ten patients, *i.e.*, seven double, three single. In one case he pegged the joint between the scaphoid and internal cuneiform. Great benefit, he says, resulted from the operation and bony anchylosis and a painless arch were obtained.

It must always be remembered that all bone operations

in any form of talipes are to be avoided, except in extreme cases and after other methods have failed, and in valgus the very large majority of cases are perfectly amenable to tenotomy, proper instruments, massage, and a correctly constructed boot and support. Moreover, six weeks is the average time needed to restore these patients to comfort by ordinary orthopædic means, whereas several months' care is required after any operation on the tarsal bones and joints.

CHAPTER XIII.

PES EQUINUS.

Synonyms.—German, *Pferdefuss, Spitzfuss*; French, *Pied bot équin.*

Definition.—In this deformity the foot is extended, the heel being drawn up, and the patient walks on the ball of the toes. In severer forms the toes may be flexed, and the patient bears the weight on the phalanges and heads of the metatarsal bones, and, in the worst cases, he walks on the head of the astragalus, over which a bursa is developed; the toes curl up and back, and the sole of the foot is much contracted and creased. The foot is also broadened, and this, added to the heel being drawn up, gives a sort of resemblance to a horse's hoof, hence the name of the deformity.

Varieties.—It may be *congenital* or *acquired*, the former being rare, but the latter common, for the paralytic deformity is often met with, though it is not so common, in my experience, as acquired valgus.

CONGENITAL EQUINUS.

Pure equinus of this form is rare. Its *cause*, like those in the other forms of club-foot not due to defective development, is said to be due to inter-uterine abnormal pressure, or mal-position in utero. It may also be due to

irritative contraction of the gastrocnemius and soleus. As the congenital forms of club-foot are rarely, now-a-days, allowed to progress, and as it is readily diagnosed, I may pass on to the neglected forms, whether congenital or acquired. The figures on the next page, of a rare case of this deformity, are drawn from a young patient of mine at the Royal Orthopædic Hospital. There was limited motion at the knees, and also at the elbows and wrists, and the labia majora were represented by depressions instead of prominences. The profile view necessitated outward rotation of the femora.

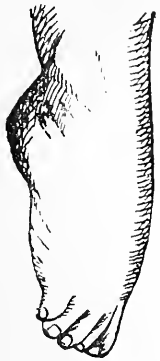


FIG. 89.—Congenital equinus.

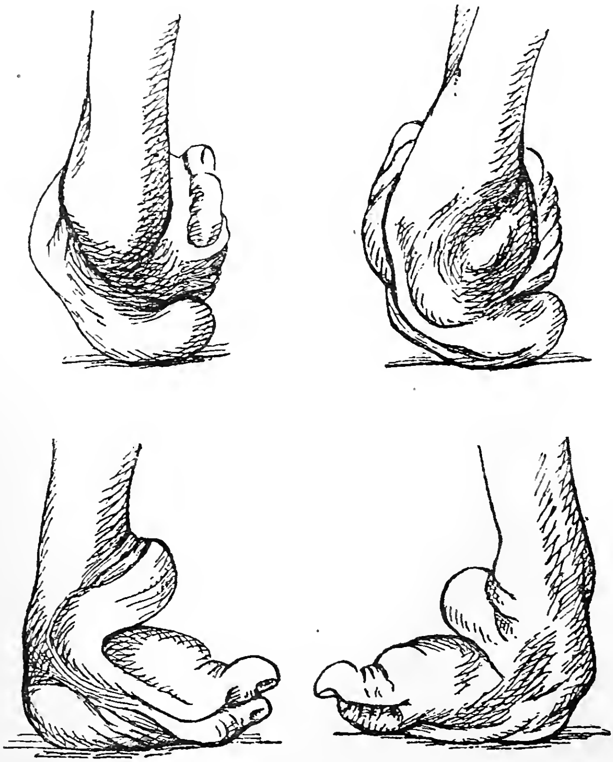
ACQUIRED EQUINUS.

Definition.—This is a deformity in which the heel is drawn up towards the calf, and the subject walks on the balls of the toes.

Causes.—These are generally *nerve lesions*, *traumatism*, or *joint* diseases. The first may be divided into paralytic and spasmodic or spastic; the next into wounds, burns, and cicatrices, and the last to the position assumed being in the direction of least pressure in consequence of the pain of articular mischief. Further remarks on this subject will be found in the paragraph on diagnosis.

Degrees and Varieties.—There appear to be *three* well-marked stages. In the *first* the heel is drawn up and the toes extended, but the foot may be forced to nearly, or quite, a right angle with the leg. In the *second* form there is more retraction of the calf muscles, and the axis of the foot and leg are in one line. In such cases the patient often walks on the phalanges and heads of the metatarsals.

In the *third*, the anterior portion of the foot is bent backwards, and the patient walks on the tarsal bones. To that form in which the toes are extended in their whole length, or only at the metatarso-phalangeal joint, the term *plantar* equinus has been given; but when the toes are flexed and



FIGS. 90 and 91.—Congenital neglected equinus from a girl aged five, seen from the front and in profile.

the patient walks on their dorsal surface, it is called *dorsal* equinus. In the former there is no marked change in the sole, but in the latter it becomes hollow and creased, and this condition may be termed *equino-cavus*. This form of the deformity may, when due to nerve lesion, be spastic

or paralytic. The former is due to irritation in the nerve centres or nerves, and is an early phenomenon, but most cases come under observation in the paralyzed stage. The symptomatic form is adverted to further on.

Pathological Anatomy.—This consists rather in a change of *position* than of *form*, except in late stages.

Bones.—The *astragalus* is only in contact with the tibia and fibula by the posterior part of its articular surface being displaced downwards, and forming a projection on the dorsum of the foot, which is due to its sub-luxation from the *scaphoid*, which is pressed downward and brought near to the os calcis, and sometimes the two articulate. The

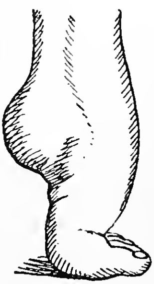


FIG. 92.—Ordinary form of equinus, the toes extended.

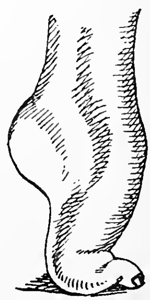


FIG. 93.—More aggravated form with the toes flexed.

posterior part of the *os calcis* is raised, and, in certain cases, may be in contact with the tibia and fibula. In some instances the calcis simply follows the astragalus, but as a rule it is not so. If the calcaneus is, or appears to be, depressed at its anterior part, so that the astragalus and it appear to approach each other in front and gape behind, the result is that the calcis is in a less extended position than the astragalus. In milder forms, the lowering of the anterior part of the foot is usually dependent on the contraction of the tendo-Achillis, but in the severer stages the plantar arch becomes contracted, and the distortion may

be dependent on this, and on the contraction of the sole muscles, producing a flexion of the transverse tarsal joint, which is a secondary result of the heel elevation. The anterior part of the calcis is, in these severe cases, subluxated from the cuboid, being raised above it. The articular cartilages gradually disappear from those surfaces not in contact with neighbouring bones. In severe cases the base of the *fifth metatarsal* may be nearly in contact with the calcis; and Chance has described a case in which a facet had formed on the calcis behind the astragalus for articulation with the tibia. In this case the articulating surfaces of the astragalus were somewhat altered. In severe cases of long standing the proximal phalanges form articular facets upon the upper surfaces of the metatarsal bones, in consequence of the anterior surface of the foot being used for the purposes of progression. In old cases, the bones have been found light and porous, but in cases of over fifty years' standing, the disease is perfectly amenable to correct orthopædic treatment.

Ligaments.—These are contracted in the sole and stretched on the dorsum. The plantar fascia is always firmly contracted in severe cases. The astragalo-scaphoid ligament may be much stretched in old cases, as are also the interosseus and calcaneo-astragaloid.

Muscles. — The gastrocnemius, soleus, plantaris, and flexor brevis digitorum are retracted in the severe cases, and, sometimes, in the worst cases, the deep muscles as well, especially the flexor longus digitorum. The peroneus longus is often shortened, and it is to this retraction that some attribute the *cavus* which is present in those cases where the toes are extended. The extensors may also become retracted through the altered position of the toes, for instance, the extensor communis and extensor pollicis, and in these cases the toes are extended; but if the flexors

be retracted the toes are flexed. The tendency, of course, is for the toe flexors to become first shortened, but if the patient bear his weight at first on the plantar aspect of the toes, these are constantly lengthened and the extensors may thus become shortened. The flexor brevis digitorum is often retracted, and with the abductor pollicis and minimi digiti help to produce the concavity of the sole, which commences, in bad cases, at the free extremities of the toes, which are sometimes bent up, and extends to the heel. This cavus differs from ordinary pes cavus, in which the concavity only begins at the head of the metatarsal bones. Pancoast says that the soleus is wholly or chiefly retracted, but experience, as well as experiment, show this view to be wrong; for if the gastrocnemius and plantaris did not influence the amount of the deformity, why should there be variations in it when the limb is flexed or extended? Instead of the soleus only being affected, one would be inclined to think that beyond the muscles just named the peroneus longus is also affected in pure equinus. We know that the muscles acting through the tendo-Achillis produce slight abduction as well as extension, and if extension be in a right line, the action of the peroneus longus is necessary to produce the deformity, and probably also, in part, that of the brevis. The tendons are rarely much, if at all, displaced in this affection; in fact, equino-varus seems to be the only distortion, which in its severe forms, produces any great displacement of tendons.

Symptoms.—The patient either drags the leg along, or swings it with a circular motion, or brings it down with a jerk from the toe to heel; the calf and the whole leg are wasted, and the former is raised. In severe cases there are transverse creases at the heel above the os calcis. The reason of these peculiarities of gait is that, the foot being extended, the limb is longer on that side. Sometimes the

patient overcomes it by flexing the knee. Secondary distortions, such as tilting of the pelvis and lateral curvature, only occur, as a rule, in late stages, when the disease has lasted a long time. Muscular retraction in these cases, as in most others, produces a greater amount of distortion than do joint deformities or ligamentous retractions, and it is very rare, if the extensors be relaxed, that the foot cannot be slightly more flexed than if the muscles were acting. If, in the irritative or spastic cases, the patient have walked for some time, the anterior part of the foot becomes widened and the toes bent. The head of the

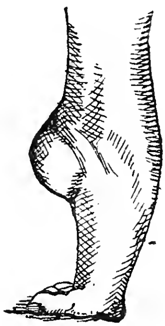


FIG. 94.—More severe form of equinus, the weight being borne on the heads of the metatarsals.

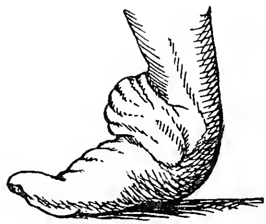


FIG. 95.—Extreme stage, the patient walking on the dorsum.

astragalus is prominent on the dorsum of the foot, the leg may become shorter and the foot smaller through improper growth. The plantar fascia and short muscles on the inner side of the foot may become contracted and cause partial inversion and shortening of this side of the foot. The ligaments of the sole are shortened, and the dorsal ones become stretched. Corns or bursæ may form in the sole at the metatarso-phalangeal joint, and if they become inflamed may give rise to much trouble. I have known these in spastic, and especially in paralytic equinus, to cause joint and bone mischief, and to simulate, or in fact become,

perforating ulcers of the foot. It must be borne in mind that in all paralytic forms pressure is very badly borne; and sores, especially in cold weather, are apt to form, and are difficult to heal. In these cases the coldness and redness, or purplish hue of the limb, and the great wasting of the muscles is obvious. The swing of the affected limb is characteristic, and the up and down gait of the patient cannot well be mistaken. The aspect of the foot will vary according to the muscles affected. If the anterior muscles are normal, the toes will be extended; but if these and the flexor longus digitorum be contracted, the distal phalanges will become flexed and clawed. If the anterior muscles be paralyzed, and the foot little used for progression or support, the toes become entirely flexed; but if much used, dorsal progression will be the result.

Diagnosis.—Not the deformity, but its cause, may give some trouble to ascertain, and the questions to decide will be whether the case be spastic, or an old congenital one, or due to traumatism or articular mischief. Paralytic cases are usually easily recognized. In slight or moderate cases, if flexion be permitted at the knee, the gastrocnemius and soleus becoming relaxed, will allow more flexion at the ankle, so that the equinus will disappear, and a severe one will often considerably diminish.

Paralytic equinus is caused by a paralysis of the extensors, and is oftenest due to infantile paralysis, but is not very uncommon in hemi- or paraplegia of adults.

In consequence of loss of nerve power, the tendons and ligaments supporting the ankle and knee joints yield, so that the foot and the knee may become valgoid and the bones altered in shape and atrophied. In slight cases, going up stairs and even dancing may be comparatively easy, but long standing, walking, and going down stairs are difficult and often painful. The reason why the heel

is more drawn up in walking than when at rest is because then the calf muscles are in action and are unopposed by the extensors. If both feet be affected, flexion of the trunk at the hips will occur in order to permit the heels to touch the ground, and, after a time, progression without the aid of crutches—with or without leg supports—is impossible. In acute cases many of these symptoms come on rapidly, but in sub-acute and chronic forms two to five years may elapse before the child is able to walk at all.

Hueter attributed the production of paralytic equinus to the position of the limbs in bed. The patient lies on the back, and the weight of the bedclothes assists the unopposed flexors by pressing on the dorsal surface of the foot and keeping it in an extended position.

Most of the cases of paralytic equinus are due to the causes already enumerated, and which speak for themselves. Here I need only speak of the variety due to *spastic contraction and retraction* of the flexor muscles, and especially of those of the calf, but it must not be forgotten that this may be a secondary result of the other causes. For instance, it may result from anchylosis after ankle disease; and this may cause a reflex contraction, or a retraction which remains after the primary disease has been cured. Wounds of muscles causing inflammation of them, and the production of cicatricial tissue, may also produce this deformity; and I have seen several instances of this after severe injuries to the leg at the London Hospital. In fractures of the leg in which the foot has not been kept at the proper angle, the same deformity may result. Injuries and diseases of the central nervous system, or of the nerves of the lower limb may, of course, give rise to the deformity. It must be recollected that it is the muscles in front of the leg which are paralyzed in these

nervous cases, so that if, in tenotomy of the biceps, the external popliteal nerve be divided, an equinus would result if the nerve did not unite.

Symptomatic Equinus.—In people with one leg shorter than the other from any cause, the toes are often pointed so as to equalize the length of the legs. This is an *accommodative* effort, and may be termed *compensatory* equinus.

Prognosis.—In the rare congenital cases this is favourable, and appropriate treatment will soon set right the deformity, but in the acquired forms it will depend upon the cause producing the deformity and the amount of damage to the parts, whether this be primary or secondary. In old spastic cases the anterior leg muscles having been long extended and inactive will have lost some of their power, but this may be overcome by massage, frictions and use, unless degeneration of muscular fibre have taken place. In paralytic cases the deformity can readily be corrected, but one must be careful not to produce the opposite condition by too rapid correction of the displaced foot.

Treatment.—In *congenital* equinus treatment should be begun early, for in old cases of this form the distortion is less amenable to treatment than are those of neglected varus or valgus. The treatment, subsequent to tenotomy, if this be necessary, is conducted on the same principles as for other forms of club-foot.

In *acquired* cases the treatment must vary with the cause Mild cases may be amenable to manipulations, and the use of appropriate apparatus, but the severer forms, whether paralytic or not, will most often need tenotomy.

Cases due to joint mischief, wounds, cicatrices, &c., must be dealt with on general surgical principles. I need only here speak of the Orthopædic methods in cases of spastic and paralytic equinus. In the former the tendo-Achillis

must be divided, but if the plantar fascia be contracted, or any of the short muscles of the foot, these should be divided first and the sole concavity corrected before the tendo-Achillis is divided, because this fixes the os calcis and forms a steady point from which to stretch out the plantar fascia, &c.

In *paralytic* cases in an early stage, faradization, frictions, and a suitable apparatus may do a good deal, but in the later stages tenotomy of the tendo-Achillis will be necessary, and before this operation is done in any variety of the deformity, the boot and support that will be necessary should be measured and ready for use when required. If the toes be secondarily contracted, these may be corrected by being strapped for some time in a proper position, but if they resist this the tendons producing the contraction must be subcutaneously divided. From four to six days may elapse before commencing the stretching in spastic cases, and a little longer interval may be allowed in paralytic forms. When the deformity is nearly corrected the use of the universal Scarpa, mentioned in the chapter on equino-varus, is very serviceable until the patient is allowed to walk, when an apparatus, as shown in one of the adjoining figures, must be used. The larger one consists of a pelvic band and an outside iron attached to a boot. There are joints at the hip, knee, and ankle, but opposite the knee there is a stop-joint which supports the knee, which is generally weak in these cases, and in severe forms is hyperextended, so as to present a convexity in the popliteal space, instead of in front. The joint at the knee permits fixation for walking, but can be shifted to allow flexion in sitting. This instrument, passing from the pelvis to the foot, prevents that rotation at the knee which is due to laxity of its supporting structures, and can also be made to prevent the eversion of the toes and valgoid condition

which is apt to occur in cases that are without treatment. These latter conditions may be due to paralysis of the tibialis anticus, or to contraction of the peronei. I should mention that there are some cases of equinus and of equino-varus, in which, after division of the tendo-Achillis, the joint appears to lock, *i.e.*, not to become fully corrected, and, in several instances, I have had to divide the peronei before the deformity was cured. Sometimes the flexor and

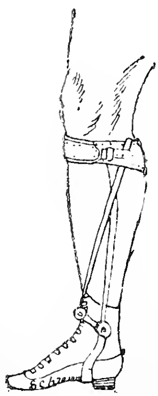


FIG. 96.—Boot and support with elastic traction for equinus.

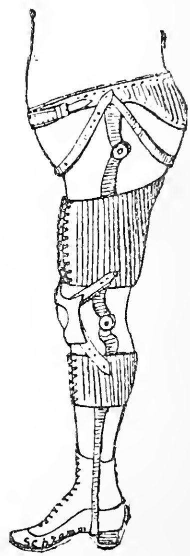


FIG. 97.—Pelvic band and support for paralytic equinus.

extensor longus pollicis, one or both, need division, and the latter especially, if the great toe be much flexed. With the treatment above given an ordinary case of spastic equinus can be cured, as a rule, within a fortnight; but severer cases, as well as the paralytic forms, require more prolonged care.

Division of the Plantar Fascia.—The patient should lie on the face, so that the foot-sole is uppermost. An

assistant grasps the heel with one hand, and the balls of the toes with the other, and stretches the foot to render the fascia tense. The operator having made out its inner border, the assistant should slightly relax the sole when the surgeon introduces the tenotome *on the flat* beneath the fascia as far as necessary, then turns the cutting edge towards it, and with a sawing motion divides it entirely, or in part, as thought advisable. Directly the tenotome is introduced, the assistant again stretches the foot, before the operator begins to cut. The fascia may be divided near its origin, at its middle, or nearer the toes. The great point is not to pass the knife too deeply so as to wound the plantar vessels. The operation completed, a dossil of lint, fixed with strapping and bandage, should be applied over the puncture, and the foot put on a flexible splint in the deformed position until the third day, when stretching of the fascia should begin.

Excision of the Astragalus for equinus was first performed by Mr. Lund, of Manchester, upon an infant, in 1877, as stated in the chapter on Varus. The head of the astragalus was exposed, the interosseus calcaneo-astragaloid ligament was hooked out and cut, the hook being sharp on its concave surface, then the astragalus was removed. This operation is only justifiable in cases occurring in adults and of long standing, after the ordinary methods have had a fair trial and failed.

CHAPTER XIV.

TALIPES CALCANEUS.

Synonyms.—German, *Hackenfuss*; French, *Pied bot talus*.

Definition.—This deformity consists in the foot being flexed upon the leg, so that its dorsum approximates the front of the leg; the heel is depressed and the sole raised.

Varieties.—It may be *congenital* or *acquired*; the former is very rare, the rarest of all the congenital forms of club-foot, and the acquired form is also uncommon, except as a result of paralysis. The congenital form is almost always associated with valgus, so that pure calcaneus is extremely rare.

CONGENITAL CALCANEUS.

Degrees.—There may be slight or severe forms of this deformity, and, accordingly, *three* degrees of it have been made: 1. When the foot is at a right angle to the leg, and extension cannot be carried beyond that point; 2. The foot is at an acute angle to the leg; 3. The dorsal aspect of the foot nearly, or quite, touches the anterior surface of the leg.

Symptoms.—If the infant be supported in a standing position, it will be found that the heel, and in severe cases its posterior part only, comes in contact with the ground, the toes being raised and the sole pointing forwards. The former are often flexed, especially the four outer toes. On

attempting to extend the foot the tendons of the tibialis anticus, extensor longus digitorum, and pollicis may be felt to be very tense. The tendo-Achillis is closely applied to the back of the tibia, and the projection of the heel is absent. Though the displacement occurs at the tibio-astragaloid joint, there may be a movement of the anterior part of the foot on the posterior, at the mid-tarsal joint, the effect of which is to flatten the dorsal convexity of the instep, and to diminish the plantar concavity. There are skin-folds and creases on the dorsum near, and at the ankle.

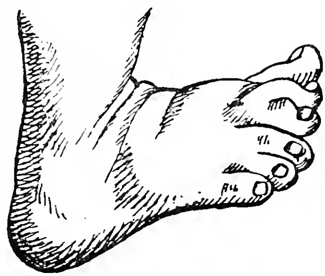


FIG. 98.—Congenital calcaneus. The patient had six toes, and the second, third, fourth, and fifth were webbed.

Pathological Anatomy.—The bones are not much altered, but the articular surfaces are somewhat modified. The *astragalus* appears to be pushed backwards, and a part of its neck is in contact with the tibio-fibular surfaces, whilst the anterior part of its upper articular facet is behind the tibia and uncovered by it. The *os calcis* follows the astragalus in its posterior movement. Lannelongue found the astragalus as if displaced towards the posterior part of the os calcis. The same writer found the astragalus somewhat defective in front though well developed behind.

At a later stage inverse changes result, and a slight displacement occurs between these bones, which leaves uncovered a part of the postero-inferior astragaloid facet, and the axes of these bones form an angle open behind.

ACQUIRED CALCANEUS.

Causes.—Of these *paralysis* is by far the commonest, though injury and disease may produce it. The too rapid lengthening of the tendo-Achillis, after section in paralytic cases, will also produce it. The *spasmodic* or *spastic* form is rare. The paralytic form is due to paresis of the sural muscles, and the consequent uncontrolled action of the anterior muscles.

Symptoms.—I have seen several well-marked examples of the deformity at the Royal Orthopædic Hospital, in various stages of the malady, and have found it most frequently as a result of infantile paralysis. In these the flexion of the foot is generally not extreme, and there is often associated with it a valgoid condition of the postero-internal part of the foot; and there is, almost always, the condition known as *pes cavus*, *i.e.*, the arch of the foot is shortened, and is higher and more concave. The character of this cavus varies with the stage of the disease and the number of muscles affected. If only the triceps suralis be paralysed there will be what Duchenne calls a *direct* cavus. In this the tibialis anticus, extensor longus digitorum, and extensor proprius pollicis, flex the foot, and the flexor longus digitorum and peroneus longus, bend the anterior on the posterior part of the foot, and form a *direct calcaneo-valgo-cavus*. In this deformity the plantar part of the anterior portion of the foot looks directly downwards.

If the peroneus longus be also paralysed the flexor digitorum longus is not counteracted by it, and there will result a *calcaneo-cavus* with varus of the anterior part of the foot, *i.e.*, with inversion of the anterior part of the sole. If the flexors be paralysed and the peroneus longus normal, a *cavo valgus* will result, *i.e.*, a cavus with the anterior part

of the sole turned outwards, but in these forms, the chief factor in increasing the plantar concavity, is the depression of the os calcis.

The toes are raised towards the dorsum of the foot if the interossei be intact, but they are flexed if these be paralysed. This is a similar condition to that known in the upper limb as *clawed* or *griffin* hand.

FIG. 99.—Paralytic calcaneus.

The patient swings the leg and brings it down upon the heel, and sometimes on the posterior part of it, and when this touches the ground the anterior part of the foot hangs, as it were, on it, unless the plantar fascia and plantar muscles be strongly retracted; the leg and foot are much wasted, and if the disease have lasted long, the bones are considerably atrophied. The limb is colder and of a bluish-purple, and chilblains, and pressure sores, are apt to form and are difficult to heal. In cases combined with valgus, the patient walks on the inner malleolus, and I have seen the bursæ which form in this situation give trouble through their inflaming.

In that rare affection *spasmodic calcaneus* the muscles on the front of the leg are contracted, and in later stages become retracted, and then must be divided to reduce the deformity.

Morbid Anatomy.—In addition to the displacement described in the congenital form, a diminution of the antero-posterior dimensions of the plantar portions of the scaphoid and cuboid result. The os calcis appears elongated and its posterior part more conical, while it has become almost vertical in position, and the astragalus is obliquely

placed to it. The *ligaments* on the dorsal surface and in the sole of the foot are contracted, and especially the plantar fascia, but at the back of the ankle they are lengthened.

Mr. W. Adams has described the feet of Chinese women in the Royal College of Surgeons' Museum. These are cases of *artificial calcano-cavus*, but they differ from the natural form in that the four outer toes are flexed, and rotated towards the mid-line of the sole. They are also depressed, being lower than the displaced os calcis. The great toe is the only one which is in extension, and this gives the pointed form to the foot. The instep is much increased on the dorsum, and this is due to the almost vertical position of the metatarsal bones, and the projections of the anterior tarsal bones articulating with them.

Prognosis.—In congenital cases this is favourable, because there is rarely any increase of the deformity, and suitable treatment will soon rectify the foot. In spasmodic cases, tenotomy with proper subsequent treatment will also do much for the defect; but in paralytic cases, entire removal of the deformity is scarcely to be expected, and even if this were done, we have no present means of restoring motion, unless the cases be seen early, which unfortunately they rarely are.

Treatment.—In infants, the deformity being spasmodic, is readily amenable to extension by splints, but if not, it will yield to tenotomy and subsequent manipulations. In these, as in adult spasmodic cases, the tibialis anticus, extensor longus digitorum, proprius pollicis and the peroneus tertius usually require division, when rectification soon occurs, and then the use of the universal Scarpa for a short time will entirely correct the deformity, which is not apt to relapse.

In *acquired* cases, of which the paralytic are by far the commonest, tenotomy of tendons is not often necessary,

but the plantar fascia, and even some of the contracted superficial plantar muscles, may need division, to overcome the cavus. If the deformity be the result of non-union of the tendo-Achillis after division, then the ends may be cut down upon, a portion removed from each, and the ends stitched together. Little, in one case, excised a portion of the tendon, and of the skin above and behind the heel, but the result was only moderately satisfactory. In another case he subcutaneously freely excised the extremities of the divided tendon, and lacerated the insufficiently developed intermediate substance, the foot was then put up in extension and the result was favourable. It has, I believe, been proposed, if not executed, to produce a cicatricial retraction of the skin of the calf by destroying it with the actual cautery or nitric acid, but such remedies seem severe as well as uncertain. A properly constructed boot and support with a stop-joint at the ankle to prevent flexion, should be worn during the day, and the universal Scarpa at night. The heel of the boot should be high, and elastic bandages should pass from the pieces encircling the leg, to the heel, so as to overcome flexion. Passive motions, massage, etc. are of value in the early stages.

FIG. 100 —Instrument for the treatment of severe calcaneus.

Excision and suture of parts of elongated tendons.—This is the deformity in which this operation is most often called for, but it may be of service in old paralytic cases of the other forms of club-foot. I have operated on several occasions in different forms of distortion, and can speak well of the plan in suitable cases. An incision

is carefully made down to the tendon, the sheath of which is opened, and it is then raised by a blunt hook or spatula, and folded or pinched between the fingers until a fold of sufficient size to correct the deformity, is ascertained. A silver wire is then passed through the tendon about a quarter of an inch above and below the parts where it will be divided. This precaution prevents the tendon slipping away up into its sheath. The ends are then approximated, the ends of the wire twisted, and buried by a few taps, into the tendon. The parts are then stitched up, and in a week gentle motion may be permitted. I have found this plan more reliable than the use of silk or gut suture, which nearly always give way and render the operation futile.

CHAPTER XV.

PES-CAVUS; OR, PLANTARIS; AND PES PLANUS

Synonyms.—German, *Hohlfuss*; French, *Pied creux.*

Definition.—In this deformity there is increased concavity of the plantar arch with dorsal convexity.

If an impression of such feet be taken, it will be found that in the milder cases the outer side of the foot will leave an impression, whereas, in the severer forms, there is a distinct break between the heel impression and that of the front of the foot (see figure). The way to take this impression is to moisten the soles of the feet in water and let the patient stand upon a dry board, or, with an ordinary painter's brush, to ink the sole of the foot and let the patient stand upon blotting paper; a correct view of the points of pressure on the sole will thus be obtained in all the various forms of foot deformity.

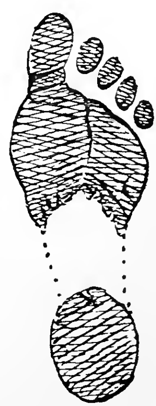


FIG. 101.—Impression of a cavus sole.

Varieties.—It may be *congenital* or *acquired;* the former being rare, and the latter has been sufficiently described in the chapter on equinus.

Causes.—The congenital forms may be due to abnormal growth of the tarsal bones, or to contraction of the abductor

pollicis and plantar fascia, but I have seen only one case necessitating their division. The acquired form may follow equinus, and it may also arise from unilateral lesion of the cord.

Pathological Anatomy.—This is little known at present, but it would seem that the deformity, in congenital cases, is due to a primitive derangement of the tarsal bones and ligaments, and especially to the inner portion of the plantar ligament.

Symptoms.—In congenital cases which have been left untreated, the patients can walk with comfort, but in others a long walk produces tarsalgia. As the points of pressure are on the heel and the heads of the metatarsal bones, especially of the big and little toes, corns and bursæ are apt to form here and thus may give trouble; but independently of this, in some cases tarsalgia is produced after long standing and walking, so that such cases may be described as *painful cavus*. In some instances the patient walks on the outer border of the foot and raises the inner border, which is also shortened and somewhat inverted, forming a *cavo-varus*.

FIG. 102.—Pes cavus. Left foot.

Treatment.—Any distinctly retracted structures may be divided in old cases, especially if there be tarsalgia, as this is often due to altered articular pressure, but in the majority of cases the sole of the boot should be well moulded and fitted to the foot, so as to take the pressure of the body weight on the middle of the instep and relieve the heel and the metatarsal joint. A splint with a sole-piece, having a slot cut out on either side of the foot, through which strapping or bandages can be passed over the dorsum of

the foot to press it downwards, may, in some cases, after sufficient time, lengthen the sole of the foot so as to bring a greater surface of it in contact with the ground. It should be recollected that in this deformity the foot is like a bow, the bones forming the wooden part and the plantar fascia and muscles forming the string, so that if the latter can be permanently and actually elongated the deformity will usually be much relieved.

PES PLANUS.

Definition.—This deformity is also known under the name of *spurious valgus* or *splay-foot*, and consists of a depression of the inner half of the plantar arch *without* eversion of the sole. In some cases of the worst form the case may pass on to become true pes valgus, but this is very rare.

Synonyms.—Flat or splay-foot, spurious valgus; German, *Platte Fuss;* French, *Pied plat.*

Causes.—This condition, like valgus proper, is generally a statical distortion, and but very rarely is it of nervous origin, except in cases of spinal paralysis. Flat foot is common in some races, as in negroes and in Jews, and, of course, hereditary in them; and it is also, not unfrequently, hereditary in some European families. The feet of the new-born are almost always flat, on account of the large pad of fat in the sole, and it is only after they begin to stand and walk, and because, and in spite of walking, that the external part of the arch becomes formed.

The arch of the foot is composed of an *outer* and an *inner* segment. The former is made up of the calcis, cuboid, and two outer metatarsals, and its points of contact with the ground are at the calcanean tuberosity and heads of the metatarsals; the latter is formed by the astragalus,

scaphoid, cuneiforms, and three inner metatarsals, and only its anterior part, *i.e.*, the heads of the metatarsals, touches the ground, while its posterior part, viz., the astragalus, rests on the os calcis, so that the outer part of the arch bears almost the whole weight of the body, transmitted through the astragalus. The outer part of this composite arch is supported by the plantar ligaments, tendons, and fascia, by the plantar muscles and by the arrangement and strength of its bones; and the cause of its sinking is to be found, generally, in some statical condition, which leads to alteration of the normal equilibrium between the body-weight and the structures which support and resist it.

Seeing that the normal form of the foot at birth is flattened, and that the arch, and especially its outer part, is formed through the process of growth and nutrition, stimulated by the acts of standing and walking; it is but natural to conclude that *pes planus* is the result of some defect in growth, or in the direction of pressure, or in both; and noting further, that the hollow at the middle of the inner portion of the sole is formed after the development of the outer section of the arch, which carries the inner up with it, one is prepared to see how a flattening of the outer arch precedes a lowering of the inner, though the body-weight causing this acts through the astragalus, which is the hindermost part of the internal segment of the double pedal arch.

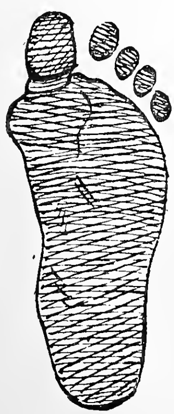


FIG. 103. — Impression of sole of flat foot. In well-marked valgus, the outer quarter or even one-third does not touch the ground.

Pes planus and pes valgus are distinct conditions, and not grades or stages of the same distortion, for in the latter there is, in well marked cases, raising of the outer border and eversion of the outer

part of the sole, and not in the former ; and the astragalo-scaphoid joint is usually normal in planus, though displaced and gaping in valgus ; and in planus there is no abduction of the foot at the ankle, as in valgus. They may, however, both be *congenital*, *hereditary*, or *acquired*, and it will nearly always be elicited, after careful inquiry, that in so-called acquired valgus or planus of adolescents and adults, the subject has always had a long flattish foot, with little elasticity or power of spring in it, and that it is only when pain and inconvenience become urgent that they apply for relief ; so that I regard the antecedent structural conditions of such feet as due either to a persistence of the normal flattened shape of the feet at birth, or to changed or arrested growth, probably, in some cases, to altered joint surfaces, the result of abnormally directed pressure during the ossification period. The large majority of cases occurring later in life are, in my experience, articular, and due to rheumatism or gout.

Symptoms and external appearances.—These are similar to those of the milder cases of valgus, and consist of inability to stand or walk for any length of time without inconvenience or pain being produced. *Tarsalgia* is sometimes present and may be due to abnormal pressure on the joints or muscles, or it may be neuralgic ; but the majority of cases of planus are more inconveniences and unsightly conditions, than serious deformities.

Diagnosis.—Eversion of the sole, or the formation of a canoe-shaped foot never occur in this condition, and the normal condition of the astragalo-scaphoid joint will also serve to distinguish it from valgus. Flat foot, the result of articular disease is always a secondary deformity and need cause no diagnostic difficulty.

Treatment.—Massage, the use of the sole-plates and boot described in the chapter on valgus, and the avoidance

of prolonged standing, walking or dancing, are the indications for treatment in the majority of cases.

COMPOUND FORMS OF CLUB-FOOT.

It will have already been gathered that these are the rule, and that the pure forms are the exception, whether in congenital or acquired cases; but for the sake of completeness, I will devote a short space to the exposition of those deformities which have been usually described as the compound forms of club-foot.

In these cases intermediate positions are assumed, so that extension may coincide with abduction or adduction, as also may flexion. These composite deformities occur often in the direction of normal motion, but in certain cases this is not so, for it may be seen that the anterior part of the foot is deviated in one direction, while the posterior is turned in another. There will thus be *two chief varieties.* In the *first and commonest* form the foot is deviated in *two directions*, while in the second it is deviated in *three.*

These deformities are named by composite words, combining the *typical-varieties.* The first part of the word being usually given to that deformity which is the more pronounced or the more important. The four chief varieties are the following:—

1. *Pes-Equino-varus*, in which the foot is in extension and *ad*duction. The equinus is often, in congenital cases, more difficult to cure than the varus.

2. *Pes-Equino-valgus*, in which there is extension and *ab*duction.

3. *Pes-Calcaneo-valgus*, in which there is flexion and *ab*duction.

4. *Pes-Calcaneo-varus*, in which there is flexion and *ad*duction.

In the severer forms in which there are three deviations the names are formed in a similar manner. It is not necessary to enter into the causes, symptoms, prognosis, and treatment, as these have been already sufficiently explained, and common sense will inform us that in these compound forms it is necessary to combine the treatment of the two or three forms in which the foot is deviated, to effect cure or amelioration.

CHAPTER XVI.

GENU VALGUM AND OSTEOTOMY.

Definitions.—*Genu valgum* is a deformity in which, on standing with the knees extended and touching, one or both knees are directed inwards and the malleoli separated; *genu varum* is the opposite deformity, *i.e.*, when standing with the malleoli touching, the knees are more or less separated.

Synonyms.—Latin, *Genu Introrsum;* English, *Knock-knee, In-knee;* Greek, *Esogonyancon;* French, *Genou cagneux, genou en dedans;* German, *Backerbein, Xbein, Kniebahrer, Knickbein, Knieng, Ziegenbein, Schemmelbein.*

Varieties.—It may be *single* or *double* whatever its cause, the double forms being commonest, but the traumatic forms are usually unilateral. It may be *congenital* or *acquired*, and there may be valgum of one side and consecutive accommodative varum of the other, or *vice versâ.* Other varieties are described in the next paragraph.

Causes.—Any of these deformities may be either *congenital, rachitic, atonic, statical, spastic, paralytic, traumatic, arthritic, senile, or inherited;* and their nomenclature and classification may be arranged according to their ætiology. Another ætiological classification is into *pathological* and *traumatic*, the former includes all those above given, with the exception of the traumatic cases. *Predisposing* causes are to be found in bad hygienic surroundings,

insufficient food, as regards quantity and quality, rickets, muscular and ligamentous debility, etc. *Exciting* causes are to be sought in errors in the mode of standing, unequally distributed pressure, the carrying of weights on the head or back, producing flat-foot and secondary genu valgum or *vice versâ*. Mickulicz considers the hyper-extension of the legs on the thighs which occurs in rickety subjects at the end of extension, and permits increased rotation of the tibia outwards, as a pathological result rather than a cause. Young bricklayers, and especially bakers, who carry heavy loads of bread and also work for hours in a warm moist atmosphere, which is relaxing to the tissues, often are affected by it.

The *atonic* cases are due to muscular and ligamentous debility, and possibly to some nerve debility also, by which the muscles are not kept in a sufficiently tonic condition; the *rachitic* are due to changes chiefly in the direction of overgrowth in a downward or inward sense, or both, of the internal femoral condyle, with or without curvature of the shaft, and in several cases changes are also found in the head of the tibia. In well marked rachitic cases the joint will frequently be found loose and the tibia rotated on the femur. In other cases there will be an appearance of rotation, on account of the tibial diaphysis being united to its upper extremity at an angle which is open externally, and also because the tibial shaft is twisted inwards so that its crest is directed somewhat inwards. A bony spiculum or process is often present at the upper and inner part of the tibia near the insertion of the internal lateral ligament.

The *pathogenesis* of most of the other forms of genu valgum and varum, as well as of those just given, has been the cause of considerable difference of opinion among surgeons of late years. These various views may be

arranged under three heads *viz :* 1. The ligamentous theory; 2. The muscular; 3. The osseous.

The *ligamentous theory* was supported by Stromeyer, Guérin, Blasius, &c.; but two opposite views were held by its supporters. Some considered that the *internal* lateral ligament was relaxed primarily, so that there was a looseness on the inner side of the joint, allowing the inner condyle to overgrow laterally and also downwards, because of the gap permitted between it and its corresponding tibial surface. Others thought that the *external* lateral ligament was primarily at fault, being shortened, and the pressure thus produced on the outer condyle and corresponding articular surface of the tibia, caused their atrophy, or rather, deficiency of normal growth, while the inner portions of the joint had more play to develop. Atrophy of the outer section of the joint is also the result of relaxation of the internal lateral ligament. To the former view it has been objected, that the relaxation of the internal lateral ligament is secondary to the changes in the bones; and to the latter, that the external lateral ligament retracts to accommodate itself to the altered position of the articular surfaces on the outer side of the joint, and therefore, this shortening is also secondary, and moreover, that there are cases in which no shortening of the ligament can be made out.

The *muscular theory* is also divisible into two opposing views. The one attributes genu valgum to *shortening* of the biceps, popliteus and tensor fasciæ latæ; the other considers the deformity to be due to relaxation of these structures. Duchenne, Bonnet, Verneuil, Guérin, Little, Adams, Brodhurst and others have supported one or other of these views, but not, so far as I am aware, to the exclusion of osseous changes, whether primary or secondary. The supporters of this theory maintain that there is a primary contraction; then a retraction of the muscles on

the outer side of the joint, and that the bone changes, if present, are secondary. The objections to this view are, that in many cases no shortening or tension of the external muscles can be made out, and that in those cases in which it exists, it is secondary. Paralytic cases are of course explanable by this theory, *i.e.*, lack of supporting power in the muscles, and of tone in the ligaments, and not by the *antagonist* theory of which I have spoken in the chapter on scoliosis. In these cases, and they are common in infantile paralysis, nearly all the muscles are paralysed, so that there are no active antagonists to produce the distortion. Verneuil admits another set of muscular cases, occurring about the age of puberty until the age of 20, in which he says that the muscles of the inner side of the thigh are atrophied, while the biceps is contracted.

The *osseous theory* attributes genu valgum and varum to primary changes in the lower epiphyses of the femur, or, to the lower portion of its diaphysis, including, in some cases, the upper end of the tibia. These bony changes may be due to rickets, whether infantile, adolescentium, or senile; or to other local inflammatory, or general osseous changes leading to hypertrophy of the inner part of the joint. In these, as in other cases, there may be atrophy of the outer portion of the joint, or this may be normal.

Of recent years Annandale, Ogston, Chiene, McEwen, Barwell and other surgeons, have acted chiefly on the belief that the main change—whether primary or secondary—was in the bones, and mostly at the lower end of the femur. Ollier proved by his experiments the influence that traumatic inflammation of the epiphysial cartilage had on the growth of the bone. Mellet in 1835* mentioned the

* "Manuel Pratique d'Orthopædie."

deformity of the condyles and thought this change to be primary, and Ollier, Gosselin, Tillaux, Delore, and others, agree with this view. Seeing that the commonest bony change, at the age at which knock-knee is frequent, is rachitic, it has been concluded that all these cases were due to that cause. But condylar deviation may be caused by curvature of the lower part of the femur, whether this curve be convex, out or inwards, and in most cases which I have seen, this change in the femur was associated with other evidences of rickets; but in some of those cases in which such other evidence was lacking, the hardened and dense condition of the bones met with while I was operating confirmed the view previously formed as to the *localization* of rickets in these cases. In a few instances of marked deformity, I have found the bones quite soft, cutting like dry cheese.

The osseous theory is not necessarily confined to rachitic cases only, for putting aside osteomalacia, arthritis deformans, and the rarer forms of bone change, it is known that injury or disease in the neighbourhood of joints, in growing people, may produce changes in the epiphyses, which being aggravated by the pressure of the body in walking, or in the various vocations of life, may lead to abnormal growth, in the direction of least pressure, and thus produce the deformity, while there is arrested growth on the side of greatest pressure. Gosselin and Ollier hold the view that there is defective growth of the external condyle due to premature inflammatory synostosis of the outer part of the epiphysial cartilage, caused by excess of pressure on it. Verneuil and others have drawn attention to the fact that in several cases the upper part of the tibia is similarly affected, and I have seen not a few cases in which the internal tibial tuberosity was enlarged and the external smaller than natural. It will thus be seen that there are

two main conditions of bone, *rachitic* and *inflammatory*, which are appealed to, and with reason, n support of the osseous theory.

There are certain objections to this theory worthy of note. For instance, in cases occurring in quite young children it has too often been assumed that the bony deformity was of a rachitic nature, even when there were no other evidences of rickets ; so that if, in such cases, the primary cause was rickets, it must have been of a purely local nature, an uncommon, though not at all an improbable, hypothesis. It may also be urged, that though there be no appreciable evidences of rickets elsewhere, the leg manifestation is its first indication, and shows itself in the parts most weakened from use, viz., in the lower limbs. Of this I am sure, that I have seen such cases, but I do not pretend to say that they are the rule.

With regard to the supposed inflammatory epiphysial changes, it may be said that children suffer from many hurts, sprains, &c., in their tumbles, and that this traumatism, through being severe, or by affecting a delicate or predisposed child, would cause an epiphysitis ; but seeing that genu valgum and varum are generally devoid of pain, whereas epiphysitis is generally a painful affection, it would lead us rather to the view that there is no inflammatory change, or that if there be, it must be of a chronic or latent character. I have asked in many cases if any so-called *growing pains* were at any time present, and more often than not have been answered in the negative. My view of those cases occurring in children and adolescents, in which the bone deformity is well marked, is, that from some unknown and at present unascertained cause, there has been an altered nutrition in the epiphyses of one or both bones forming the knee joint, and that this change is oftenest *primary*, and that the contracted state of the biceps and

internal lateral ligament, if present—which in my experience is anything but the rule—is *secondary*.

I think all will agree, that any of the theories mentioned are too exclusive to explain the varying phenomena met with in studying a large number of cases of these deformities. Genu valgum is not, as a rule, the result of but one cause, originating invariably in only one set of structures; but is frequently due to a series of causes, some of which are primary and of more importance than the rest, and of these my experience has taught me that the bony cases are of more frequent occurrence than the atonic or those due to muscular and ligamentous weakness.

Seeing that in the bony cases the deformity is due to overgrowth and elongation of the internal condyle, with or without overgrowth and curvation of the lower and inner portion of the femoral shaft (Mickulicz), with consequent twisting out of the condyles (McEwen), or of the outer and lower part of the diaphysis of the former (Delore), with, in some cases, corresponding changes in the upper end of the tibia (which some consider primary), it remains to explain the probable mechanism by which the distortion is produced in the *atonic* cases. To do this satisfactorily a little space must be devoted to the consideration of modern views as to the normal anatomy of the knee joint.

In the *normal joint* there can, I think, be no doubt that the internal condyle is longer than the external, so that if the femora were not inclined inwards at their lower ends the femoro-tibial articulation would be oblique from without down, instead of being practically transverse. This inward inclination is due to the wide separation of the femoral heads at the pelvis, and is necessitated in order to preserve the line of gravity in its proper position. Its amount depends on the width of the pelvis and on the length of the femora, and these differ not only in the sexes,

but in different individuals of the same sex. It has not yet been pointed out that the *law of asymmetry* may be an important factor in the genesis of the statical forms of these deformities. I see no great difficulty in attributing some of these cases to the want of symmetry on the two sides of the body, so that the femur, which originally was somewhat longer and heavier than its fellow, has, through excess of accommodative strain, gradually become more valgoid. It may be objected, that if this view were true, females ought to suffer more than males, being naturally more valgoid at the knee, and I would reply, that I am not sure that they do not; for women are very apt to conceal any deformity, though I admit that we see the deformity more often in boys than in girls. This can be explained by the fact that boys grow not only relatively, but, also, I am inclined to think, absolutely, faster than girls, and the former are more exposed to the action of causes which could take advantage of any predisposing circumstance. I do not claim that the law of asymmetry will serve to explain all cases, but I venture the hypothesis as a tenable one, when other better known causes are shown to be absent. We know that when one leg becomes shorter than the other from some pathological reason, the long one may become either valgoid or varoid according to the position most suitable to, and most assumed by, the patient, but the above explanation of this fact has not been previously alluded to. It must also be clearly apprehended, that the ordinary line of body weight-pressure through the middle of the lower tibial articulation, is taken from a perfectly formed limb, and how few are perfectly formed? I am sure that in both general and special pathology, sufficient regard has not been paid to the fact that the majority of individuals are anything but perfectly formed, even in their normal condition; and that these primary imperfections may be im-

portant predisposing causes for various maladies and deformities.

In the normal state, on standing with the feet together, the femur and tibia form an angle open externally, the femur being inclined inwards, while the tibia is almost vertical, and the greater the width of the pelvis the less open becomes the femoro-tibial angle, for the inward projection of the lower end of the femur is more marked. This is very noticeable in well developed women, but is partly concealed by the greater relative amount of subcutaneous fat in the thighs, especially at their upper and inner parts.

Degrees.—In atonic statical cases (*i.e.* those caused through long standing, walking, and wrongly directed pressure in delicate subjects) there are commonly *three stages* and grades of the deformity. In the *first* stage, there is stretching of the internal lateral ligament through the altered direction of the axis of pressure towards the inner side of the joint, and Mickulicz has found this internal ligament tense and hypertrophied, instead of relaxed, and Owen and Linhart have made similar observations. The last named observer found the external lateral ligament lengthened, but this is quite exceptional. Probably the crucial ligaments, especially the posterior portion attached to the internal condyle, is also stretched. Lannelongue has found the posterior crucial rudimentary, and anterior absent. If the patient now come under observation, the case would be considered a mild one. In the *second* stage the tendon of the biceps, the external lateral ligament and the ilio-tibial band of the fascia lata, all on the outer side of the joint, become contracted, and this serves to increase the deformity. In the *third* stage bony changes become more noticeable. The internal condyle becomes enlarged laterally, also elongated and separated from the tibia; and if the ligaments on the

inner side be very lax, a depression can be distinctly felt between the femur and tibia ; but as a rule the enlargement of the inner condyle fills the gap that would otherwise exist between the bones, or the internal tibial tuberosity enlarges and fills the gap, but this is exceptional, in my experience. The external condyle and outer tuberosity of the tibia, having to bear the body weight, become pressed together, and either atrophy or cease to grow, and thus serve to accentuate the deformity.

Morbid Anatomy.—Much of this has been given in the preceding paragraphs, but a complete summary of existing knowledge will be useful. The most pronounced change is in the bones forming the knee joints, and especially at the lower end of the femur, the internal condyle of which, or the lower third and inner part of its shaft, is overgrown and curved inwards and downwards. The internal condyle is *often really elongated*, though in several cases it is displaced downwards by the lengthening of the inner side of the femur. In rachitic cases, there are often found internal or external curvature of the femur and tibia at the lower or upper ends, and sometimes in both. Sometimes there is an external curve at the lower third of the femur, the concavity of which is internal, and the effect of this is to cause a difference in the relative lengths of the condyles. The lower epiphysis of the femur may also be twisted or rotated out (Volkmann). The external condyle is flattened and shortened, and the articular cartilages are hypertrophied on the outer, and atrophied on the inner side of the joint, and atrophic changes have also been observed in the outer inter-articular cartilage. The internal articular surface of the tibia is a little larger and shallower than normal, and its internal tuberosity may be enlarged. This bone is, in some severe rachitic cases, rotated—generally inwards—so that the tibial crest is directed somewhat

inwards and is often curved at its upper, but more often at its lower, part. Rotation outwards of the tibia is common in these cases, and an osseous spiculum is frequently present near the insertion of the internal lateral ligament, in bad rachitic examples. The condition of the tendons and ligaments on the outer side of the joint are *secondary* and have already been described, and the other muscles moving the knee are sometimes not well nourished, and are thinner and longer than normal.

In certain non-rachitic cases occurring about puberty, Mickulicz has shown that the femoral and tibial epiphyses

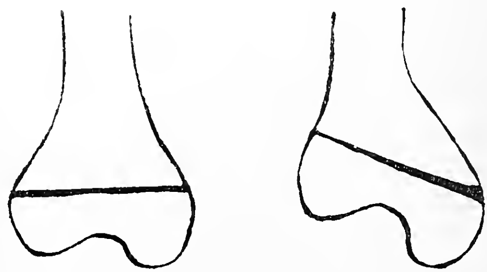


FIG. 104.—Diagram of a normal and abnormal femur, lower end. (After Mickulicz.

nearly preserve their normal length, and that the changes in their position are due to pathological changes in the epiphysial cartilage. He found the internal portion of the lower femoral epiphysis thicker than the outer, and considers that "the alteration in length on the inner side of the femur arises not from alteration of the epiphysis, but is confined to the lowest part of the diaphysis" as represented in the adjoining figures. A corresponding deviation of the tibial diaphysis is also present in some cases. Microscopic examination showed that the cartilages were in a similar condition to that found in rickets, so that these cases furnish evidence in support of the purely local occurrence of rachitic

changes, and serve to explain the occurrence of the adolescent and senile forms of the distortion. It must however be mentioned that the dissections of Chiari tend to show that there is *real elongation* of the internal condyles, and the autopsies of de Santi, Guénot, and Lannelongue* have proved this to exist in their cases.

It will thus be seen that, in many cases, the old view attributing genu valgum to elongation of the internal condyle, is, in part, correct, though researches show that the elongation is apparent rather than to any great extent real, for it is pushed and displaced downwards by overgrowth, in length, of the inner side of the lower third of the femur. For practical purposes, it being shown that in the majority of such cases the internal condyle is lower than the outer, however produced, pathology may be disregarded. I think that the explanation of this curve, convex inwards, met with in several rachitic, and in some non-rachitic cases, is to be explained by the downward growth of the shaft being checked by the vertical pressure at the knee in standing and walking, and so growth takes place laterally, and causes broadening of the internal femoral tuberosity and of the lower end of the shaft. The vertical pressure also causes the young cartilage of the femur to yield inwards in the direction of least resistance, and that of the upper part of the tibia to overgrow internally, and to yield at the junction of the shaft with the tuberosities, so as to form an angle open externally.

Symptoms.—The *subjective* symptoms are few, and vary with the degree and cause of the deformity and nature of the case. Pain at the inner side of the knee, which may be increased on pressure, is sometimes complained of, but is not often severe. The great complaint is that of soon becoming fatigued, and inability to stand for any time, or to walk any distance. The *objective* symptoms are pro-

* "Peyre, *Thèse de Paris*, 1879."

nounced in two directions: in the *gait* of the patient, and in the *aspect* of the deformed limbs. The gait is characteristic. The knees being slightly flexed, and the inner condyles touching or overlapping, the legs have to be separated at the knees to permit of progression, and at each step the knees yield internally, producing a sort of half roll, half jerk. In *unilateral* cases this peculiar gait is diminished by

FIG. 105.—To show the shortening caused by genu valgum. Taken from a lad on whom I subsequently performed diaphysial osteotomy.

inclination of the hip to the affected side, and by slightly flexing the thigh on the sound side, the inequality of the limbs is remedied. In double genu valgum, sufferers diminish the characteristic walk by flexing both legs.

Genu valgum is more common in boys than girls, on account of their more active habits, and of their mode of employment among the poorer classes. It developes more especially at two periods, viz., from the second (when the child has walked for a time), to the fourth year, and from puberty to sixteen or seventeen years, and may increase

until the period of growth is over, or, in rachitic cases, when this process has been completed.

The affected leg or legs will be found to be directed down and outwards, so that on standing there is a considerable gap between the malleoli. Often there is a rotation of the tibia outwards, but in some severe cases I have seen, it has been, as before mentioned, rotated inwards, so that the anterior leg muscles, instead of presenting on the outer, were on the anterior aspect of the leg. There is a marked projection at the inner side of the knee, in most cases, and this is due to the overgrown internal femoral condyle, and also in some cases to the overgrown upper part of the tibia. The patella is often carried out and articulates with the front of the external condyle, and, in the worst cases, it is dislocated quite outwards. The movements of the joint are free, and in consequence of the laxity of the ligaments, in some of the cases, and especially the rickety ones, there is considerable active and passive lateral motion permitted; abduction and external rotation of the tibia are also increased, as is also extension, in several cases. Hueter explains this in the following way. There is, on the anterior aspect of each condyle, a triangular facet (described by Goodsir and Henle) just below the patellar facet, and extension ceases when these facets are in contact with the glenoid tibial surfaces, through the intervention of the inter-articular discs. In genu valgum, the facet on the external condyle is more hollow and depressed, and thus permits a greater amount of extension.

A very remarkable fact is, that of the almost complete *disappearance of the deformity when the knee is flexed* to a right angle. Several explanations have been offered. Lannelongue attributes it to the absence of the crucial ligaments, permitting rotation and perfect application of the leg to the thigh during flexion; but this has not been shown to be the rule in knock-

knee, and will not suffice. Guénot thinks that the increase of the internal condyle is only in its length, and not antero-posteriorly, and that in flexion the tibial articular surfaces come in contact with the posterior surfaces of the femoral condyle, and at this point the condylar surfaces are normal. Gérard's explanation is hypothetical. He thinks that the posterior part of the internal condyle is less prominent, or that the corresponding part of the external is more prominent. Busch's explanation is the most satisfactory on anatomical and mechanical grounds. He says it is due to the downward displacement of the internal condyle causing an obliquity of the articular line, and a consequent oblique axis of rotation. If, as in the accompanying figure, a foot-rule, with a Charnier's joint at right angles to its axis, be moved, the movements of flexion and extension will be in the same plane. If the joint be obliquely placed the rule will be straight in complete extension, but deviates more and more with increasing flexion from the early flexion plane.

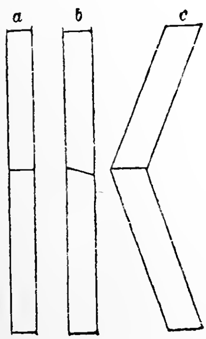


FIG. 106.—Diagram to explain the disappearance of genu valgum on flexion.

But if the two limbs of the rule be joined at an angle in complete extension, and this be gradually flexed, then this angular bend will diminish with increasing flexion, and will disappear when flexion has reached 180°. It is this mechanical condition which causes the disappearance of valgum with increasing flexion, and though the mechanical conditions are more complicated in knock-knee, than in a simple rule, it is the *obliquely directed axis of rotation* which is the chief factor in the disappearance of the valgus in increasing flexion.

Complications.—In severe or old standing cases,

secondary deformities result. These are shown in the feet, spine, and opposite leg. The former may be in temporary varus or valgus. In the latter the toes are generally turned out, and *vice versâ* in the former, and these distortions result from the patient's efforts to preserve the centre of gravity and to minimise the effects of the deformity. The varied position may be due to efforts to overcome the primary valgoid tendency, and may result from trying to keep the entire sole applied to the ground. Scoliosis, either temporary or permanent, may occur, and the severity and permanence of it will depend on the deviation and nature of the primary deformity. If only one leg be affected, or if one leg be shorter than the other, in double cases, a not uncommon occurrence, secondary scoliosis is apt to form, and the primary lumbar curve will be in the direction of the shorter limb. In some severe cases of single genu valgum a *compensatory* or *accommodative* genu varum of the opposite limb occurs, and I have operated on several such with perfect correction of both deformities. The possibility of these deformities developing in some cases simultaneously, should not be forgotten. This deformity, rendering the sufferer weak in his supports, exposes him to injuries of the knee; and also in some instances to dry or effusive articular mischiefs. Bursæ may also, in severe cases, form at the sides of the internal condyles through friction and pressure. The leg-bones may also yield in various directions in rachitic cases, but chiefly in an anterior or internal direction; and if this be extreme, the subject walks on the inner side of the foot and inner malleolus, and genu valgum may be secondary to this condition.

FIG. 107. — Severe valgum and varum cured by diaphysial osteotomy.

Measurement of the Deformity.—The eye will often enable us to say whether the case be mild, moderate or severe ; but measurement will furnish accurate information, and is valuable in showing us the effect of treatment. The methods of Tillaux and Mickulicz are unnecessarily complicated and need not detain us. The patient may be in the erect or recumbent posture, (I prefer the latter) and the knees touching, care being taken that the patient do not conceal some of the deformity by internally rotating the femur. Then the limbs may be measured on the outer or inner side, or on both. In the former plan, a measuring

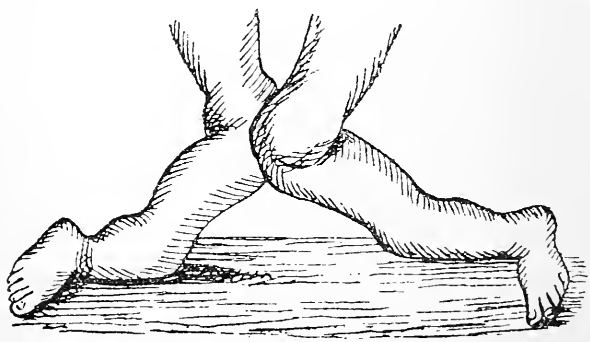


FIG. 108.—Extreme rachitic genua valga and curved tibia.

tape, or a long wooden graduated measure, takes the length from the top of the great trochanter to the tip of the external malleolus (see figure), and a hand rule measures the height of the angle opposite the knee. These measurements should be recorded. In the latter, an ordinary long splint, suitable to the size of the patient, should be accurately placed in the mid-line, the knees should be made to touch it, and the distance of the malleoli from it accurately noted. To the former plan it has been objected, that the angle formed by a slight deformity in a long limb, will coincide with a considerable deviation in a short one ; but if

the measurements are made on, and relate to, the same subject, there need be no difficulty. Marchand and Terrillon proposed to measure the angle formed by the femoral with the tibial axis; but this is somewhat difficult, and not necessary, as the two methods just given suffice for all practical purposes.

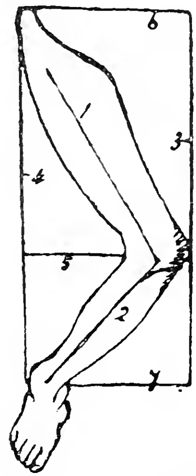


FIG. 109.—Diagram of how to measure the amount of a genu valgum. The lines 1 and 2 indicate the axes of the femur and tibia. See text.

Prognosis.—Since the successful application of osteotomy to these cases this is always favourable. I speak chiefly from my personal experience of the operation, and shall point out any accidents that may happen, in the ensuing paragraph.

Treatment.—This must vary according to the severity of the case and to some extent according to the cause. The object being to bring the limb into a normal position, the only question is as to the best mode of doing it. Until about the last dozen years, no *rapid* methods were known to, or generally adopted by, surgeons, and treatment was confined to splinting and tenotomy. Reduction may, now-a-days, be accomplished *gradually*, or *at once*; and even in *forcible manual* or *instrumental straightening*, complete reduction need not be attempted at once, but may be done piecemeal at several sittings. The surgical treatment consists in the use of splints, instruments, and in operative procedures. The instruments are divisible into two kinds according to the nature of the case, *i.e.* those allowing the patient to walk, and those for use only when the patient is in a recumbent posture. The *operative procedures* may be divided into five: viz., 1, tenotomy and gradual reduction; 2, forcible reduction; 3, osteotomy; 4, osteoclasy; 5, epiphysial

chrondrotomy. There is external wound only in tenotomy, osteotomy and chrondrotomy, but the first is subcutaneous and the second practically so.

In *slight cases*, relieving the limbs of the body weight, and the application of well-padded splints to the outer or inner side of the limb, will often suffice. Some surgeons prefer to act on the inner side, using the internal condyle as a

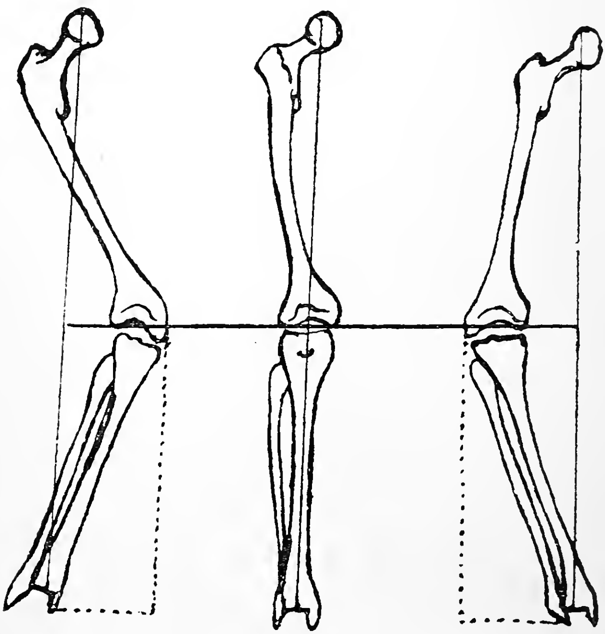


FIG. 110.—Diagrams of a normal lower limb (middle figure), of a genu valgum (to the left), and of a genu extrorsum (to the right). A vertical line passes through the head of femur and middle of ankle joint, and a transverse one through the knee-joints, showing the altered levels of the internal and external condyles.

fulcrum, and taking leverage from the malleoli, thus gradually drawing the leg or legs inward. Others prefer applying the splints on the outer side, taking the fixed points at the trochanter and external malleolus, and slowly forcing the knee outwards, and yet others apply splints to both sides of

the limb. Similar results can be obtained, in those who can afford an instrument, by the use of one properly constructed, as shown in the accompanying figures. These, though admitting of knee flexion, should be kept rigid at that joint by the use of the ring-bolt or spring-catch, as immobilisation of the knee has given good results in many cases, and patients

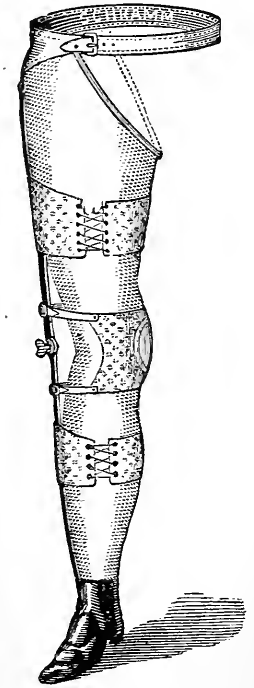


FIG. 111.— Instrument for genu valgum, with perineal band.

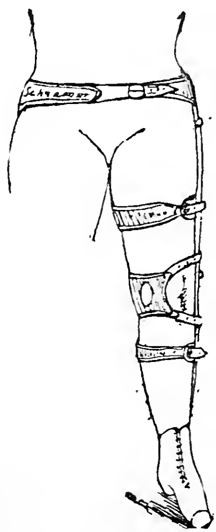
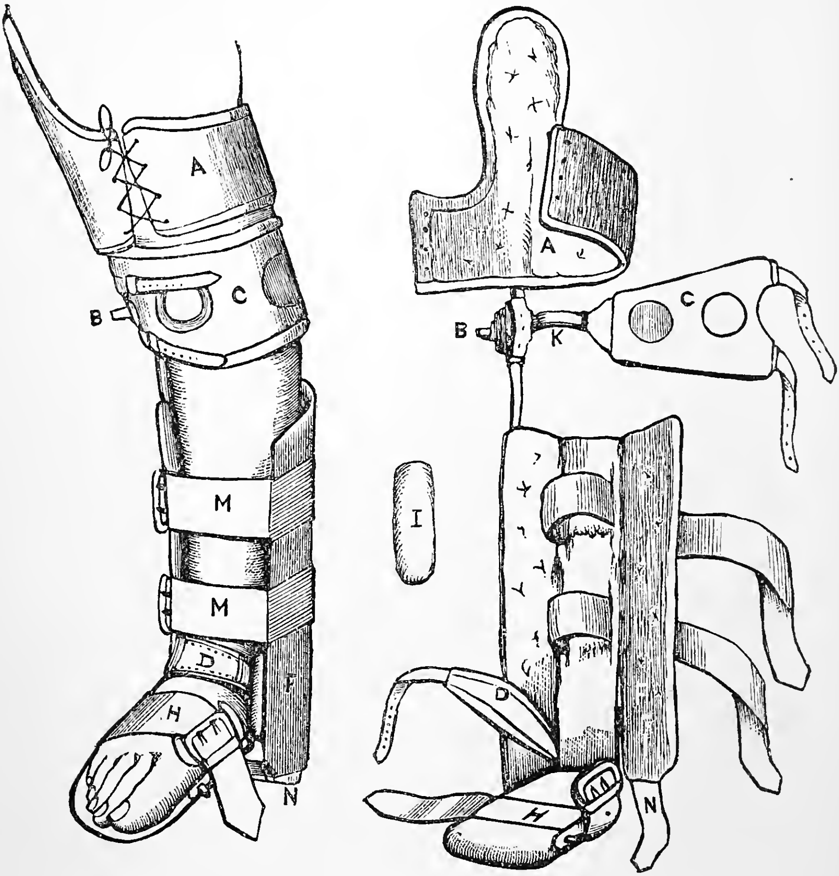


FIG. 112.—A lighter form of genu valgum; instrument with spring catch.

soon accustom themselves to walk fairly well even with the knees kept extended. In many of these cases such methods, though slow, are efficient.

When there is a *medium degree* of the deformity, and especially when the means just mentioned have failed, *tenotomy of the biceps tendon* and possibly of the *ilio-tibial*

band, may be called for, especially if these be tense. Division of the external lateral ligament results in a loose joint, and in recurrence of the deformity, if the patient walk



FIGS. 113 and 114.—Mr. H. Baker's instrument for genu valgum, after tenotomy, to keep the knee extended and prevent rotation of the leg. A. Thigh-trough ; B. Cog-wheel ; C. Knee-band ; D. Ankle-strap ; F. Side-wing ; H. Inside toe-strap ; I. Pad to go between heel and F. ; K. Extension bar behind knee ; M. and N. The wing-straps. The left-hand figure shows the instrument applied.

without an instrument. Langenbeck and others divided this ligament over forty years ago, and the results were very unsatisfactory. Bonnet and Guérin had also done these

operations previously. After tenotomy the limb is put up in the deformed position for three or four days, and then a splint—for which the patient has been previously measured—is applied, the limb safely secured so as to prevent rotation, and by the use of a joint on the outer side, the limb is gradually straightened. This process is slow, and is often interrupted through pressure excoriations. When these occur, the apparatus must be loosened or removed, and

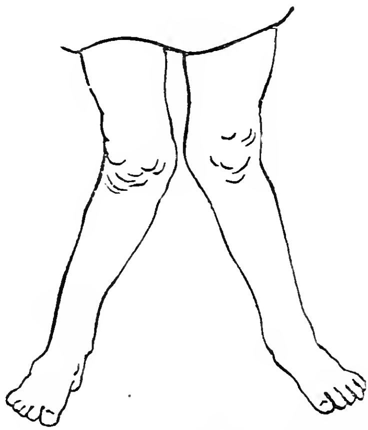


FIG. 115.—A case of atonic double genu valgum in a girl aged nine, which was cured by tenotomy of biceps and subsequent use of a genu valgum correction splint. This is only one of many similar cases.

spirituous lotions applied to harden the skin, and to lessen inflammation.

Tenotomy of the Biceps.—The patient lying on his face is told to flex the limb, while an assistant gently resists this motion with one hand, and steadies the thigh with the other. The tendon is thus rendered prominent, and the operator passes the tenotome vertically between the tendon and the external popliteal nerve about an inch above the joint, from within outwards and towards the skin, while the assistant is stretching the tendon, and directly he feels all resistance gone he should immediately relax. The surgeon

will feel a gap between the severed ends of the tendon, and should keep his knife well under control during the operation to prevent its coming through the skin. Not that this rare accident is serious to life, but it is most undesirable, as in unhealthy subjects suppuration may occur, and in any case a largish scar will be left instead of a mere punctured cicatrix. The peroneal nerve has been divided in this operation by inexperienced operators, and this was followed, in some cases, by temporary, and in others, by permanent paralysis. Even experienced operators have met with this accident, as Tamplin relates a case in which he divided the nerve, but the paralysis only lasted six to eight weeks.

The following indications may be of service in preventing this accident. After the biceps tendon has been divided, the peroneal nerve will sometimes be felt quite distinctly stretching along in the neighbourhood of the operation; but if the patient be told to flex the limb it will be found, if the tendon have been properly divided, that no prominence occurs in its course as before the operation, and a gap will easily be felt between its severed ends. This will suffice to show that the cord-like structure is the nerve, and not an undivided part of the tendon. In case of doubt, the assistant should extend the leg, and it will be seen and felt, in properly conducted cases, that the tendon has been thoroughly divided. If the tendon have been transfixed and only partially divided, there will be more difficulty in differentiating the remaining portion of it from the nerve; but, it will be observed that attempts to straighten the limb are resisted, whereas this would not be the case if it had been thoroughly divided. If the nerve have been divided, the best course is to put up the limb in the deformed position for ten or fourteen days, or until such time as suffices to furnish indications of its functions being restored. If union do not take place in a month, the nerve should be

cut down on and its end pared and drawn together by catgut stitches passed through the neurilemma. I have adopted this proceeding in old wounds of the forearm of many months' standing and have been successful, and other surgeons have met with a similar success at much longer intervals. If, in this operation, the tenotome be passed too deeply down towards the bone the superior external articular artery may be wounded, but pressure combined with rest and returning the limb to its original position would, I think, suffice to check this.

In *mild and moderate* cases, and even in some severe forms, Hueter put into practice his plan of curing by *altered position*. As already explained, he thinks that hyper-extension of the joint is often present and as a causative influence, so he puts up the limb in a semi-flexed position and keeps it so for a considerable time. Several German surgeons have tried this method without success, and as it leaves the existing deformity untouched, the only hope is, that pressure being taken off the lower aspect of the condyles, the external will be allowed scope to make up for its retarded development, while the internal will only grow very slightly if at all.

In the *third class* of cases in which the deformity is *severe* or of *long standing*, and especially in rachitic and severe statical cases—always granting that the eburnating stage has occurred, or is taking place—we must resort to more radical measures, after giving a fair trial to the means already mentioned. In hospital practice, where the services of children from ten to fifteen are of great service to their parents, valuable time need not be wasted in the further trying of splinting, &c., especially as operations are, in my own experience, which, as regards number of operations, is second only to that of McEwen, absolutely safe. These consist of—1. Forcible straightening, the *rédressment brusque*

of Delore of Lyons, which may be manual or instrumental; 2. Osteotomy and Osteectomy; 3. of Osteoclasy; and 4. Epiphysial Chondrotomy. The joint has been excised by Mr. Howse of Guy's for genu varum and valgum, but none will, nowadays, repeat these operations.

Forcible manual reduction is thus done by Delore. The patient being anæsthetised, the affected limb is placed in external rotation, an assistant keeping the external malleolus slightly raised from the table, and the surgeon exercises successive and slightly increasing pressure-jerks on the front of the knee, which is upwards, *i.e.*, the patella looks upwards. Presently, cracking sounds are heard, and the limb can be put straight. Tillaux operates in an opposite way, *i.e.*, uses the internal condyle as the *point d'appui.* The limb is so placed that the internal condyle rests on the edge of the table, properly protected, and the surgeon grasps the knee to prevent rotation, with one hand, while assistants steady the thigh; with the other, he holds the leg just above the malleoli, using it as a lever, the internal condyle being the fulcrum, and the leg hanging beyond the table. Then he exercises sharp and successive jerks and pressures on the leg, until cracking sounds are heard and the leg can be straightened. The time for this varies in different cases from five to twenty minutes. I have had cases which yielded fairly readily, and others which gave great trouble before reduction occurred. The limb is then put up in gum, silicate, or Paris plaister, or between straight splints, and in most of my cases an icebag was applied over the joint. The limb is kept quiet for from three to six months, then the joint stiffening is overcome by passive motions, massage, &c., and the patient must only be allowed to walk with crutches for another year; but, in some cases, the limb fractures were restored in six months. In some of my cases I adopted gradual forcible reduction

at three or more sittings, and Kœnig, and others, have used the same method.

Delore has operated on 200 such cases, and other surgeons' cases must bring the total up to 300 at least, and only two deaths have occurred, so far as I know, and these were, Delore's case, due to scarlatina, and Tillaux's, caused by pyæmia. The autopsy in Delore's case showed changes like those which had been observed in experiments on the cadaver.

The cracking sounds during the operation were due to tearing of the periosteum of the lower $\frac{1}{3}$ of the femur by the external lateral ligament; to separation of the epiphyses at the inner condyle of the femur, and of the external tuberosity of the tibia, and of the head of the fibula; to the elasticity of the femur and tibia, and to gliding of the loosened epiphysis of the femur and tibia up and inwards. The articular surfaces were not in contact on the outer side of the joint.

Experiments on the dead bodies of children from fifteen months to two years old, by Samuel, Barberin, Barber and others, confirm Delore's observations. In seven cases the femoral epiphysis was alone separated, and twice with the tibial epiphysis; three times the tibial epiphysis was alone separated, and the external lateral ligament was torn in three cases, but this does not appear to be the case in the living, for the periosteum and epiphysis yield in preference to the ligaments. In the cadaver this is reversed, for in Santi's twelve experiments the external lateral ligament was ruptured nine times, twice the external condyle was separated, and was once fractured into the joint.

Though in several there was no noticeable local or constitutional mischief, still, in many cases, there has been arthritis with effusion and rise of temperature; and the separation of the periosteum has caused severe periostitis and superficial

necrosis, more than once. Tillaux had a death from pyæmia after the operation. It is, however, right to state that these as *immediate* results of the operation are exceptional, and if we consider the age of the patients operated on, (this method not being suitable after the age of twelve, though Delore puts the limit at eighteen) and recollect how well children bear operations as a rule, we should not expect them. In them the epiphysis separates much more readily than the ligaments tear, and if the operation, in rachitic

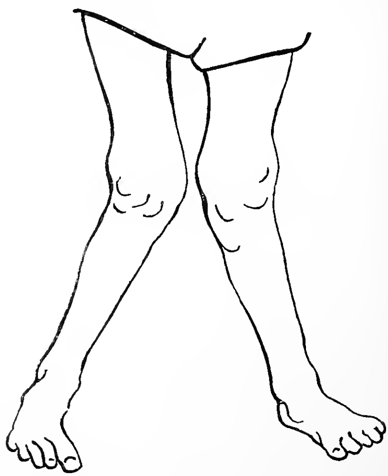


Fig. 116.—A case of double genu valgum in a boy aged 7. which was straightened by Delore's method.

cases, be done during the stage of softening, the comparatively easy separation of the epiphysis in such cases, is just that which allows the deformity to be reduced.

After twelve years of age, and after the period of sclerosis in rachitic cases, the operation is not advisable, because then the ligaments, and especially the external lateral, are ruptured, and one or both condyles fractured, and the least inconvenience resulting is an articular looseness. So that this operation, which may be called *manual osteoclasy*, is

anything but a thoroughly safe one, and is far inferior to osteotomy, both as regards safety and permanent usefulness of the joint. Moreover, one cannot satisfactorily tell what has occurred, whether an epiphysis has separated, which is desirable, or whether a fracture of the condyles, a rupture of the ligaments, or a separation of the periosteum have occurred; or whether, as has happened, the femoral shaft has been broken.

The *remote* results of the operation are a weak and lax joint, necessitating long rest before it can be used with any safety, and then the frequent necessity of a retentive apparatus, not only to permit of safe progression, but to prevent relapse. Delore states that epiphysial disjunction does not impede the development of the bone, and Barbarin has proved that in fracture of the lower end of the femoral shaft, if the epiphysial cartilage remain attached to the epiphysis, proper nutrition will be provided for. However, as there may be risk of defective growth after the injury, I think all will agree that the operation should be abandoned. In my opinion it is rough and unsurgical, and I shall never again repeat it. I expressed this opinion some years ago, and though Fochier defended this operation at the London International Congress of 1881, not a single voice was raised in its favour. On the other hand, it must be mentioned that osteotomy (and the antiseptic method also) has been very slowly received in France, and that Bœckel, Beaurigard and Tillaux, are about the only surgeons who have practised it, the first named pretty extensively, however. Our neighbours, though quick by nature, are very slow to accept English or German novelties; and perhaps we should not blame their conservatism, seeing that they do not very readily accept the new devices of their own *confrères*, though when an operation is established, they are quick to find any evidence which their surgical records or

oral tradition, furnish of French priority of discovery, suggestion, or practical application.

Forcible instrumental reduction.—A few words concerning this method, for the sake of completeness. One great objection to Delore's method is the great amount of force sometimes necessary, and the difficulty in regulating it. He has called in the aid of eight assistants, in some cases, before the cracking sound, followed by reduction, was obtained. To avoid this, and at the same time be able to measure the amount of force put forth, Colin, a Parisian instrument maker, constructed an apparatus to effect the same purpose. I need not describe it.

Osteotomy and Osteectomy.—Osteotomy may be *linear*, *cuneiform*, *rounded*, *etc.*, the former plan only deserves the name of osteotomy, for the latter are really *osteectomies* as a portion of bone is removed. Osteotomy may be *complete*, as when the whole thickness of the bone is cut through, or *partial* as when only $\frac{3}{4}$ or $\frac{4}{5}$ of it are severed, and the rest broken. This is the usual method in operations for genu-valgum, varum, and in curved tibia and fibula. The other methods of osteotomy have been used for mal-union of fractures, bony anchylosis of hip, knee, elbow, &c., and will be found described in the chapter on anchylosis. The illustrations on page 268 will show the line of the incisions in the bones. Chronological sequence is sacrificed to correct classification.

There are thirteen different operative plans foı genu-valgum and varum which may be thus tabulated.

Osteotomy of femur ...	Condylotomy with saw (linear, complete)	Ogston
	Condylotomy with chisel (linear, incomplete)	Reeves.
	Supra-condylar (linear *internal*, incomplete)	McEwen.

Osteotomy of femur ...	Supra-condylar (linear *external*, incomplete)	Reeves.
	Diaphysial (linear *external*, incomplete)	Reeves.
	Epiphysial chrondrotomy (may be done)	Ollier.
Osteectomy of femur...	Bicondyloid (really a partial excision)	Annandale.
	Cuneiform of internal condyle ...	Chiene.
	,, ,, ,, ...	McEwen.
Osteotomy of tibia ...	Linear (incomplete)	Billroth.
Osteectomy of tibia ...	Cuneiform	Meyer.
On tibia and fibula ...	Osteectomy (cuneiform) of tibia, and linear complex osteotomy of fibula .	Schede.
On femur and tibia...	Linear (incomplete)	Barwell.

Osteotomy is an old operation, for Hippocrates recommends it for badly united fractures, and it was practised in the time of Paul of Egina. Albucasis, a little later, wrote in favour of the use of the saw in preference to refracturing badly united bones. Cucherilli* says he also recommended osteotomy in anchylosis consecutive to juxta-articular fractures. Many centuries elapsed before the question was revived, but this is not the place to write a history of osteotomy in general, therefore I will refer those interested in this matter to the work of McEwen, and especially of Campenon, on Osteotomy. Some historical references of more recent date will also be found in Dr. Little's recent work on *In-kree distortion.* I will only briefly refer to the history of those methods which have application to orthopædic practice. In 1570 Déchamps used cutting forceps for correcting a badly united fracture. In 1815 Lemercier excised the ends of the tibia for vicious callus. In 1816 Wasserführ did the first linear osteotomy with open wound for a badly united

* "Lo Sperimentali," May, 1878.

fracture of the femur in a child; in 1826, Riecke and Rhea Barton performed osteotomy at the femoral neck and trochanter for anchylosed hip; and in 1835, he did cuneiform osteotomy for anchylosis of the knee, and was speedily followed by Kearney Rodgers. In 1834, Clémot* of Rochefort instituted cuneiform excision of vicious callus, and was followed, probably quite independently, by Rhea Barton. These operations were all by open wound, and the saw or forceps, or both, were used. In 1840, Jobert de Lamballe performed the first osteotomy for rachitic curvature, and in 1847, Maisonneuve did the first osteotomy in France for anchylosis of the hip. In 1854, *subcutaneous* osteotomy was introduced, and it was first suggested by Malgaigne in his work on *Fractures and Dislocations* in 1847; so that the honour of the *idea* belongs to France, though two German surgeons, Meyer and Langenbeck, *first practised* it for mal-union of fractures and rachitic curves. The operation was done in America by Brainard (1854) and by Pancoast (1859), and became popular for a time, but thereafter was only occasionally practised, being in this respect like most methods of treatment, fashionable for a season, until the mind became satiated with the new surgical toy. In 1850 to 1851, Meyer of Würzburg, a surgeon paying great attention to orthopædics, performed the first osteotomy for genu valgum. His patient was very rachitic, and Meyer had in mind more the correction of the rachitic curve than the genu valgum, as he operated at the seat of greatest curvature. In 1852, Langenbeck proposed osteotomy in two cases of anchylosed knee, and his plan was to perforate the bone in two places with a drill, and to pass his fine saw into one of the holes and saw through the intervening part of bone, then to break the bone. McEwen is incorrect in saying that Langenbeck did these operations, for he only proposed them, but

* "Gazette Médicale de Paris," 1834, p. 347.

the patients declined. In 1859, Pancoast perforated the femur in six places with a strong gimlet, through a single subcutaneous opening, just above the knee for anchylosis, and Brainard repeated the operation in 1860, using a perforator. In 1862, Sayre operated for anchylosed hip; in 1868, Stromeyer Little operated with a chisel for anchylosed knee; Brodhurst in 1865 performed subcutaneous osteotomy; and in 1869 and 1871 Adams did subcutaneous section of the femoral neck for bony anchylosis of the hip, and was soon followed by Gant, Maunder, and by me. It was not till 1875, encouraged by the antiseptic method, that Annandale *excised* a portion of the femoral condyles for genu valgum. His operation was in reality a partial excision of the joint, and the honour of introducing a method which was the precursor of our present more perfected modes of dealing with genu valgum, varum, &c., is due to Ogston junior, of Aberdeen, who operated in May 1876, by a small wound and using a saw, and was followed by Schede in September of the same year. In this method the joint was opened under strict antiseptic precautions; but *antiseptic osteotomy* was introduced by Volkmann of Halle for anchylosis of knee in 1875, and the first operation of this kind in Great Britain was by McEwen of Glasgow. Billroth introduced the use of the chisel in 1870, and in 1873 did non-antiseptic linear osteotomy of the tibia, in 1872 for genu varum, and in 1873 for valgum. Schede of Berlin did cuneiform *osteectomy* of the tibia and osteotomy of fibula for knock-knee in 1876. In 1877 Chiene of Edinburgh did cuneiform osteectomy of part of the internal condyle, and in 1878 McEwen chiselled out a wedge of the inner condyle along Ogston's line. Ogston's, Chiene's, and McEwen's cuneiform operations have been termed *osteo-arthrotomy*, or *inter-articular osteotomy;* and although my condylar plan has been included under this

* "Deutscheklinik," 1854, Vol. 6, p. 327.

head, experience has shown that it is *practically*, *i e.* as regards its effects on the joint, an extra-articular method. In the same year Barwell performed "simultaneous multiple osteotomy" for knock-knee; and in 1879 I introduced an operation in which I used the chisel, and termed it *extra-articular osteotomy* or *condylotomy*, the object of which was to avoid entering, or doing serious damage to the joint, and at the same time, to loosen and properly replace the displaced condyle. That the operation differed essentially in principle from Ogston's operation, and that its immediate and remote results—though most of my cases were done non-antiseptically—were very satisfactory, is not only testified by my cases and those of my colleague at the East London Children's Hospital, Mr. R. Parker, but is shown by the fact that Professor Annandale of Edinburgh, and many other British and foreign surgeons, freely adopted it, and were well satisfied with its results. Mr. Warrington Haward, in his excellent *résumé*, "A Treatise on Orthopædic Surgery, &c.," gives the preference to this operation, and Mr. Barker of University College Hospital, and many other surgeons, showed their appreciation by adopting it. All other operations were abandoned by unprejudiced and cautious surgeons until McEwen's *supra-condyloid* method, first done in 1877, became generally known. This plan has been largely used, but I hear from many quarters that it is being superseded by the operation which I first did and described in the *British Medical Journal* in 1881, and which I then called *mid-femoral* osteotomy, but a better name is *diaphysial* osteotomy. The object of this operation was to get well away from the joint, to have a much smaller section of bone, to avoid cancellous tissue, to have less secondary or compensatory deformity, and to hide this under the muscles; to save time in the process of bony union, to avoid inflammatory effusion into the joint, and injury to the epi-

physis, and also to prevent hæmorrhage, and splintering of the condyles into the joint. As Campenon* says, there have been three distinct phases in the choice of operative procedures. In the *first*, with Annandale and Ogston, one boldly opened the articulation. In the *second*, represented by Reeves and by Chiene, one endeavoured to respect it. . . . . In the *third*, one leaves the joint at a distance and does not operate in its neighbourhood, like Billroth and McEwen; but rather like Reeves (2nd method) and Taylor, one carries the section to the diaphysis." The early operations were conceived under the belief that the internal condyle was elongated and was the chief, if not the sole, cause of the deformity; but the last few years of practical experience have proved that whatever and wherever the pathological changes may reside and predominate, in those cases suitable for the operation, the distortion can be effectively and permanently corrected by *diaphysial* linear osteotomy. I need not occupy space by describing all the various methods. Those interested will find them well summarized in Campenon's work, and the adjoining illustrations will convey a good idea of the nature of the different operations. It will suffice to describe the three plans which have found most favour and yielded the best results, viz., the *supra-condylar*, *chisel-condylotomy*, and the *diaphysial*.

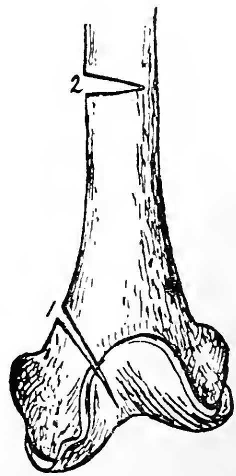


FIG. 117.—Diagram to show where the bone is divided in 1. Internal condylotomy; 2. Diaphysial osteotomy.

Supra-Condylar Osteotomy by McEwen's plan is done thus. The instruments required are a scalpel (double

* "Du redressement des membres par l'Ostéotomie," 1883.

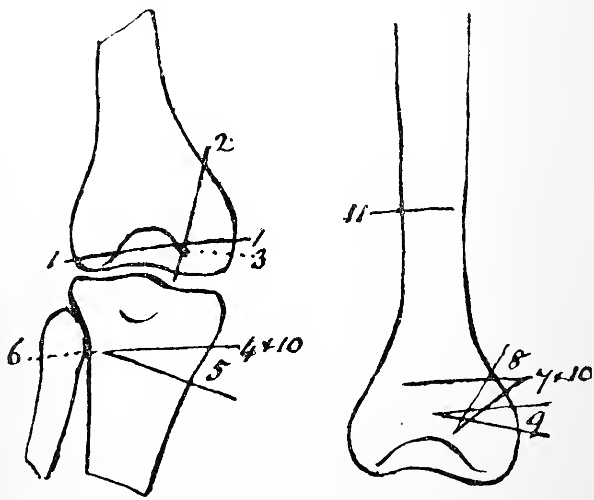
edged, I prefer), a chisel or osteotome, which should be graduated into inches and parts of an inch, and a mallet made of lignum vitæ, boxwood, or steel. I prefer the former, and have often used an ordinary mallet. The markings of the chisel are serviceable in measuring beforehand the depth it is desired that it should penetrate the bone, which, being remembered, will tell us when attempts may be made to break the bone. A sand-bag, or thick wooden or leaden rounded, or oblong block, well covered with a folded towel, to place on the opposite side of the limb to be operated on, and kept in place by an assistant, is advantageous. The sand-bag, if sufficiently large, needs no assistant. McEwen uses Esmarch's bandage. I have never used it, and see no necessity nor advantage in it, but rather the reverse, as hæmorrhage is apt to follow its use, and has pretty often occurred in this operation. I have seen troublesome hæmorrhage at the time of operation by the internal plan without the use of the elastic bandage, and have recently heard of a case in which the bleeding point had to be sought for, and joint mischief, followed by serious results to the limb (I am not sure as to the life) of the patient, necessitating excision or amputation, was the consequence. Splints, or Paris plaister bandages, should be ready at hand. The patient being anæsthetised, Esmarch's bandage is applied, and a large bag containing damp sand is placed beneath, or on one side of, the limb to
5 be operated on, to resist the blows of the mallet. A clean incision, rather larger than necessary to admit the largest osteotome, is made at once down to the bone on its inner side, about an inch above the condyles. Keeping the scalpel in position, it serves as a guide on which to introduce the osteotome, which, on reaching the bone, is turned at right angles to it, and the mallet applied. The strength of the blows will vary with the hardness of the bone, and can only be acquired after experience, some bones, even of young chil-

dren, being very dense, while others are easily severed. The bone being about three parts cut through, is then broken from the *inner* side, either forcibly, or better, by several successive sharp jerks against the surgeon's knee, his hands grasping and steadying the femur while he uses the tibia as a lever. The limb is then straightened, the wound stitched up or covered with antiseptic dressings, if the operation be done antiseptically, and put in splints or plaister of Paris. McEwen uses a special splint, and during the operation advises the use of chisels diminishing in size. I think this a bad plan, for the soft parts are apt to receive additional injury and increase the tendency to suppuration. The after-treatment, according to McEwen, consists in being watchful that the circulation in the feet is right, to take the temperature regularly, to look out for blood-stains on the dressings, and if there be any, to change them, otherwise they may be left for a fortnight and then changed. In from a month to six weeks the bone is consolidated, and the patient is allowed to flex the knees, assisted, if necessary, by passive motions. Walking on crutches is then permitted, and in ten weeks after removal of the splints the patients have firmly united limbs and may walk with supports.

FIG. 118.—Graduated chisel or osteotome.

I have followed McEwen's directions, as regards site of operation, in three cases, but have in several operated from the *outer* side, and was the first to introduce this modification, which for several reasons I consider preferable. McEwen's preference for the internal method has reference to certain mechanical views. His reasons (*op. cit.* pp. 144–7) are, *first*, that the section of the femur at this point is conical, the base being external, so that by the internal method the

surgeon cuts towards the base from the apex, and that in it, the chisel is not apt to slip and wound the soft parts and the femoral artery. There is confusion in this paragraph, for he first states that a disadvantage of the *external* incision is that the surgeon cuts towards the base, and lower down he says that, in the *internal* plan, "one cuts from an apex towards an osseous base," &c. That these objections are



FIGS. 119 and 120.—Diagrams to show the lines of bony section in the various operations for genu valgum. 1. Annandale's; 2. Ogston's; 3. Points to where my incision ceases; 4 and 7. Barwell's plan on both bones; 5. Shows the wedge of tibia removed by Meyer and adopted by Schede with section 6 of fibula; 7. McEwen's; 8. McEwen's cuneiform; 9. Chiene's cuneiform; 10. On femur, McEwen's supracondylar; 10. On tibia, Barwell's tibial section; 11. My diaphysial operation.

fanciful ample experience has proven, and that the section of the bone at this spot is not conical in the sense of base and apex, but rather resembles a basic section of an irregularly-shaped cone, figure 22 at p. 121 of McEwen's book sufficiently shows. *Secondly*, that the wedge-shaped opening on the outer side further shortens the already shorter side of the limb. This I fail to see, though of course in straightening the leg a large gap will be left, but when filled

up, as in my experience it invariably does, and that in the same space of time as in the internal method, the outer and shorter side of the leg will be properly lengthened. Moreover, that McEwen's statements and illustrations were published under an incorrect conception of the mode in which correction of the deformity is obtained will be obvious to all, if the following simple experiment be made. Draw the lower end of a femur and place the tibia in juxtaposition, at the angle it has in an average case of genu valgum. Cut through the condyles at the line of McEwen's incision, and replace the parts, then it will be seen that it matters not on which side the incision has been made, for on bringing the tibia into a right line with the median body-plane, a large gap on the *outer* side does and *must* occur, in any case. It is often impossible, without further operative procedures, such as tenotomy of the biceps, &c., to properly correct the deformity without it. *Thirdly*, the supposed ill effects of stretched or torn periosteum I have never witnessed, though a large and, for some time, ugly mass of callus has appeared at the seat of operation in the external, as in the internal methods. *Fourthly*, he says, " that though suppuration would rarely take place, still, if it did so, it would not readily find vent, owing to the manner in which the tissues on the outside of the thigh are bound down by the fascia latea " ; and he mentions two cases of the external operation by other surgeons, in which suppuration occurred (in spite of Listerian precautions, I take it, as in many other cases I know of) and counter-openings had to be made. All I can say in reply to this (and taking into consideration many other cases of antiseptic linear osteotomy, including some of McEwen's own cases), is, that in an experience of osteotomy second only to McEwen, in which, in only six cases were antiseptic precautions adopted, and that of all my cases only six sup-

purated, and two of these were supposed antiseptic cases, that all had perfect limbs, and *none died.* Four of the cases that suppurated broke out in scarlatina or measles from a few hours to three or four days after operation, and were instances of the so-called *traumatic form* of these diseases. Some remark is needed with reference to McEwen's *fifth* objection "that the production of straight useful limbs by the external plan is no sufficient reason for preferring that plan." He satirically illustrates his meaning by mentioning cases of fractures of the thigh in genu-valgoid patients, after severe accidents, being rectified by being put up in a straight position, and asks if one would adopt that method. My reply is, "Certainly, we do imitate the plan, but we adopt surgical instead of blind force." I, in my time, like most surgeons with large surgical opportunities at a hospital like the London, which is the hospital *par excellence* for accidental surgery, have corrected knock-knee and bow-legs in patients admitted with fractured thighs, by using extension and long straight splints; and the only wonder to me is that none of us thought sooner of making use of this valuable lesson. That excellent correction and perfectly useful limbs result from the external incision there can be no question, and that it is anatomically and surgically preferable to McEwen's plan, ought to go almost without saying. There is no fear of bleeding, the side which it is desired to lengthen is attacked, and as the bone may be broken from the inside the chisel can be kept in place while this is being attempted, which would be awkward according to McEwen's plan; but in it, the bone could be broken from the outside, though this would militate against his mechanical theory. He says that the outer side is the shorter. Is this so to any great extent? If a tense tape be put from the anterior superior spine or great trochanter to the external malleolus the limb will be found shorter, but if the *bones themselves* be

measured the result will be very different, and this is why on correcting the deformity we do not get the amount of lengthening we might, on superficial consideration, expect.

If the supra-condylar operation be adopted the external incision is preferable, for the reasons above given, but there are other serious objections to the supra-condylar method which must be stated. It is too near the joint, and effusion is apt to occur through laceration of the supra-patellar pouch of synovial membrane, or through inflammation extending to it and the joint cavity. There is an ugly hunk of callus for some time at the site of operation. More or less stiffness of the joint has resulted as a consequence of this operation. Serious and nearly fatal bleeding, necessitating further operative measures, have occurred, and splintering of the condyles into the joint, as recorded by Little, Rabagliati (*Brit. Med. Journal*, 1883), and others. Langton of St. Bartholomew's, McGill of the Leeds Infirmary, and Jackson of the Sheffield General Infirmary have recorded—the two former in the *Lancet* and the last in the *Medical Press and Circular*, July 9, 1884—serious mishaps, and even death, due to this operation. Mr. Jackson says, in speaking of McEwen's operation, "But are there no accidents, sometimes leading to death, of which we hear nothing? Mr. Langton of St. Bartholomew has, all honour to him, published one. I know of others; and it is highly probable that the popliteal has been wounded both in Ogston's and McEwen's operation on the femur." He proceeds to mention a case of Ogston's operation, done with the strictest Listerian precautions, getting pyæmia and empyema. But now, the diaphysial operation has been for some time in our hands, and as it fulfils every indication for the correction of the large majority of cases of these deformities, and is free from the risks of the other methods, no surgeon need hesitate as to its choice.

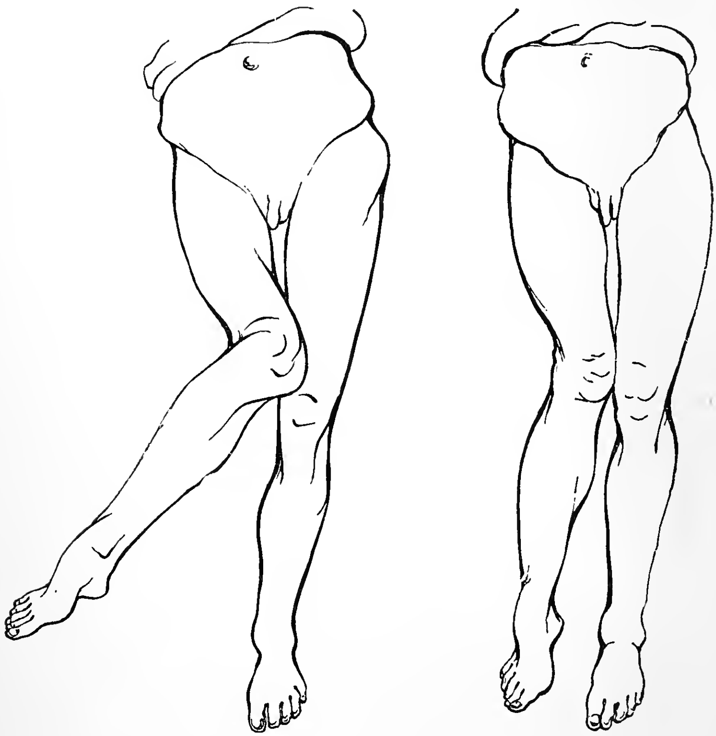
Internal Condylotomy.—This operation was first described by me in the *Brit. Med. Journal*, 1876. Its object was to loosen the elongated or displaced internal condyle and to push it up, and thus to restore the normal position of the joint. The patient being anæsthetised, the knee is flexed to a right angle to render the condyles prominent, so that the length of the inner one may be taken from the point of entry of the chisel to about a quarter of an inch from the articular cartilage, and also to pull the sub-crural pouch of synovial membrane out of the way as much as possible. A scalpel, dipped in oil either medicated with carbolic acid or thymol or plain, is passed obliquely above the internal tuberosity down to the bone. I used to pull the skin up or down before making the incision, but this is not needed, the operation being done with the knee flexed, so that when straightened the incision does not coincide with the wound of the bone. The chisel, previously dipped in the oil, is passed beside the scalpel, and the latter is first malleted into the condyle obliquely inwards, care being taken to notice the distance it should penetrate, which should be previously inked or chalked on it; but now the exact measurement can be recorded on the graduated osteotome.* I used to measure by placing the chisel on the front of the condyle, allowing for the depth of the soft parts at the tuberosity. The chisel should then be carefully and partially withdrawn with a lateral motion, and its axis changed anteriorly and posteriorly so as still further to loosen the condyle; and then, if necessary, it may be gently used as a lever to further loosen it, and when it is felt to be sufficiently loose, the leg is to be grasped and drawn firmly and steadily inwards, when a soft cracking noise will be heard,

* I believe Mr. Parker, my colleague at the East London Children's Hospital, first suggested this.

and the leg will come straight. In severe cases I used to *over-correct* the deformity and put the leg up in very slight varum, but this is not necessary. A pad of oiled lint is placed over the wound (which may be stitched if desired), a thin layer of cotton surrounds the leg and thigh, this is covered by a thin flannel bandage, and then plaister of Paris rollers are applied. An ice-bag was often applied over the knee for several days after the operation. Neither spray nor antiseptic dressings were used, and it was extremely rare to get any rise of temperature or local mischief, though sometimes temporary effusion occurred. The wound was not looked at till the bandage was removed, which, in my early operations, was in about three or four weeks, but later on I had the bandage removed in ten to fourteen days—not to look at the wound, for experience had taught me not to trouble about that—but to allow of gentle passive motion, and it was found that the patients could flex their knees to a considerable extent. The splint was re-applied and removed every day for gentle active and passive motion, and in three or four weeks the patients could stand and walk, though it is not advisable to allow this for some two or three weeks longer. This operation led me to introduce two important innovations into surgical practice, viz. (1) *to leave the wound alone* unless there were distinct indications to interfere with it, and (2) *to commence passive motion early*, and these methods have since been largely adopted by surgeons.

There are certain objections to this plan which are to some extent valid, but at the time the operation was introduced it was acknowledged to be a great advance on its predecessors, and in practice proved to be so. The theoretical objection about the joint being of necessity opened has, I am happy to say, never been proved by cases operated on, though *post-mortem* experiments show

that this is apt to occur. The only *clinical* evidence of this is furnished by those few cases in which there has been effusion, and even this may have been due to the force used in straightening the limb. In some cases it was



FIGS. 121 and 122.—Extreme genu valgum in a young man of seventeen before and after condylotomy, according to my plan. The case was sent me by Mr. Morris, of Tottenham, the cast is at the London Hospital, and the photographs were shown at the Clinical Society and acknowledged to be the worst case seen by those present, my colleague, Mr. Brodhurst, among the number.

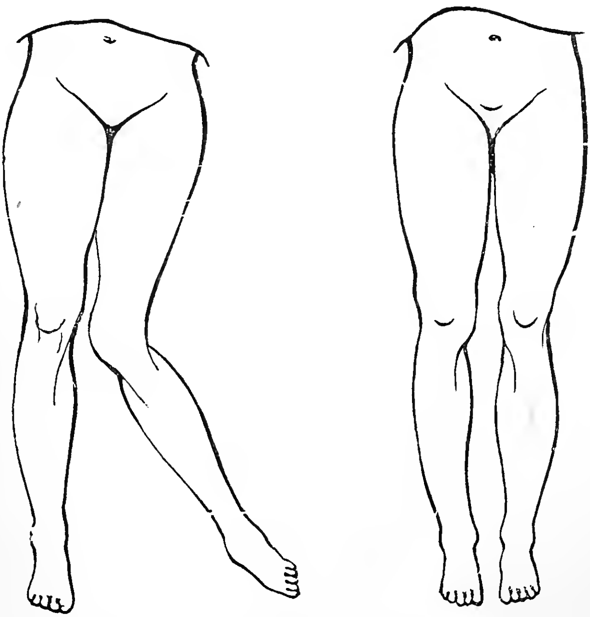
necessary to divide the biceps tendon, as done in some instances of Ogston's operation, before entire rectification occurred. Granting, for the sake of argument, that the joint is always opened in these cases, experience has abundantly shown that practically, it matters not, and in this

sense the operation is properly called *extra-articular*. Tearing of the outer structures, as in Delore's method, should not, as a rule, occur if the operation have been properly done, and especially if the biceps be divided in case of difficulty. Stiffness of the joint has occurred, but only temporarily. Relapses are unknown to me up to the present date, as also are defective development of the inner side of the femur, or epiphysial necrosis; but there are two cases to which I will draw attention as furnishing valuable lessons. In a lad aged seventeen, with extreme genu valgum (see Fig. 121)—the cast and photographs of which, when shown at the Clinical Society, were acknowledged by experienced surgeons to be the worst they had seen—whose internal condyle was extremely elongated and flattened from before backwards, so as to be less than half its natural thickness at its upper part, and the lower quarter of whose femur was much curved inwards, the condyle became comminuted, and there was extensive bleeding, so that the joint filled twice, and I pressed the blood out of it and kept up pressure while the limb was being straightened. I did not put my finger into the wound, but the broken bones could be felt to be like a bag of large marbles, and the blood came pretty freely through the wound. Here was a compound comminuted fracture into the largest joint in the body, complicated with hæmorrhage. I put a pad of lint over the wound and plaister of Paris bandage in the ordinary way. At eleven at night, the house surgeon, Sir Andrew Clark's son, sent for me because bleeding had stained the plaister and oozed up the thigh and down the leg. The lad was flushed, had a rapid pulse, and temperature of nearly 101°. My first idea was to remove the bandage and to see if I could check the bleeding, but I decided to continue with the ice-bag and to push morphia to ease the pain. I left instruction that if no improvement occurred I was to be

summoned. I heard no more from the house surgeon, and at my next visit, temperature, pulse, &c., were normal, and the bleeding had not recurred. In four weeks from the date of operation the plaister was removed, and the lad could voluntarily flex his knee to a considerable extent, and in another fortnight left the hospital with a straight limb, lengthened nearly three inches, and with perfect motion, though with a broadened joint. In this case the joint was considerably broadened by the deformity. This lad was from a suburban workhouse, and I cannot but think that if I had disturbed his bandages to examine the wound, the result would have been most serious. Had this case occurred to a Listerite it would undoubtedly have been claimed as a great antiseptic success. I do not quote it as an example to be followed either antiseptically or aseptically, *i.e.*, with cleanliness without antiseptic dressings and the spray, but merely to show what nature can do, even in a badly fed workhouse lad, when left to herself, and without meddlesome surgery. As to where the bleeding came from I did not know, but feared that a spiculum of the comminuted bone had punctured the popliteal artery or vein or the superior internal articular. The result would tend to contradict this view, but wounds of large vessels are sometimes recovered from if a fair chance be given them.

The second case conveys a different lesson. It was one of double genu valgum. I loosened both internal condyles at one sitting and put them up slightly over-corrected. This case was brought to me about three months ago, among the out-patients of the London Hospital, five years after the operation, and there was noticeable, though not severe, genu extrorsum. This was due to free growth of the previously smaller external condyles. The inner condyles were smaller than the outer, and the extrorsum

was probably due, either to excessive growth of the outer condyles subsequent to the operation, which relieved them of undue pressure, or to defective growth of the inner; and this *may* have been a result of the operation having interfered with the inner part of the epiphysial cartilage. The over-correction of the deformity may have aided in this direction.



FIGS. 123 and 124.—Severe genu valgum and slight secondary varum in a girl aged sixteen, before and after internal condylotomy.

Here I may mention another complication which may occur when passive motion is resorted to in a case of osteotomy. It occurred recently at the London Hospital, in a girl aged thirteen. The dresser, one day, on using passive motion, about a week after it had been commenced, felt something crack, and I found on examination that the upper epiphysis of the tibia had partly separated. Both

femora had been divided in their shafts, the right about a month before the left, and that gave no trouble. The tibia became firm in three weeks, but the whole left limb behaved very differently to the right, and in a manner I have not before met with, there being temporary œdema of the left thigh, and on this side it was that the tibia became fractured. In a case of sub-trochanteric osteotomy for bony anchylosis of right hip in a man aged fifty-four, the leg became œdematous when he was allowed up, and this condition is one which not very uncommonly happens after simple fractures of the lower limb.

Diaphysial Osteotomy.—This operation was described by me in the *Brit Med. Journal*, 1881, and since then I have almost invariably adopted it, and have by it been able to correct severe deformities. It consists in dividing the femur from the *outer* side at the junction of its middle and lower thirds. I do not use Esmarch's bandage in this operation, nor the spray, nor antiseptic dressings, and I make it a point not to change chisels unless one become blunt. I am sure that in the six or seven cases in which temporary suppuration occurred, it was caused by having to change chisels, and the difficulty in so doing of accurately finding the opening in the bone without doing damage to the soft parts. I have already given my reasons for preferring it, and need only say that the after-treatment consists in leaving well alone, and not removing the plaister until the bone is consolidated, which is usually in four or five weeks. Passive motion of the knee is then resorted to, and the patient allowed to walk on crutches for a short time longer, and then discharged cured. If, in correcting the deformity, the leg is not as long as its fellow, extension with a stirrup should be applied, taking the fixed point for the strapping along the lower fragment. This should only be moderate, as in the event of there being

sufficient reparative power, the greater the gap between the bones, the longer will be the healing process. The limb should be kept in the corrected position and well extended till the plaister sets, or a long and broad straight splint, well padded over the trochanter, internal condyle, and malleoli, should be applied on the outer or inner side, till it sets. I prefer the inner, because in bandaging the limb to the splint when on the outer side, the loose ligaments of rickety, *i.e.*, the commonest cases, stretch and allow of some correction of the deformity, which disappears afterwards, and this may lead to some disappointment in the result, whereas I have not found this to be the case when it is applied on the inner side. If the opposite limb be straight it may be used as a splint, and the internal condyle and malleolus being well padded, the knees and ankles are made to touch and bandaged together until the plaister is quite firm. I may now state that I have never met with non-union either in the femur or tibia, though such an event may occur; but as it has almost never happened in the practice of those of large experience in osteotomy, it may be that this result is due to inexperience, or to some constitutional or local fault in the patient, or to a piece of muscle having got between the fragments.

Osteectomy or Cuneiform Osteotomy consists in removing a wedge-shaped piece of bone from the shaft or condyles of the femora, or from the tibial shaft. This operation is not necessary in genu valgum or varum or in bowed tibiæ, and is not now practised.

The following account of osteotomies for various deformities done by me during the last ten years renders a full and accurate account of all hospital cases, and includes three private ones. These are the only cases I have done out of hospital. Severe deformity is rarer in

the well-to-do classes, as cases are treated in their early stages and bone operations are usually declined.*

Table of Osteotomies.

I must mention that there have been no deaths, no joint suppuration, nor anchylosis. All the cases made good recoveries with good position and motion. In many instances an addition of one, two, or more inches were added either on one side or on both, as circumstances dictated. I have always used the chisel and never removed any bone. Several of the cases were simultaneous double osteotomies of either the thigh or leg bones. I only used Listerian precautions in six or seven cases, and these were not vigorously carried out; and when I add that suppuration only occurred in six cases, and that two of these were attempted to be done antiseptically, and that in four of them the traumatic form of measles or scarlatina supervened, I need say no more in addition to that I have previously stated to prove the perfect safety of the operation in experienced hands.

I had thought, knowing how soon with large opportunities cases mount up, that the number of my osteotomies would have been greater, but in this I find myself mistaken.

For Deformities of Lower Limb.

Condylotomies.

12 for genu valgum, 10 double and 2 single	=	22
5 for genu varum, 4 double and 1 single	=	9
		31 condylotomies.

* Since the above was written I have operated on seventeen other cases for deformities of the lower limb, and all did as well as I could wish.

OSTEOTOMIES.

77 for genu valgum, 63 double and 14 single	=	140
27 for genu varum, 20 double and 7 single	=	47
93 for bowed legs, 65 double and 28 single	=	158
17 for anchylosis of hip, 2 double and 15 single	=	19
7 for anchylosis of knee, all single	=	7
3 for malunion of femur	=	3
2 for malunion of leg bones (both bones) ...	=	4
		478 osteotomies on lower limb.

FOR DEFORMITIES OF UPPER LIMB.

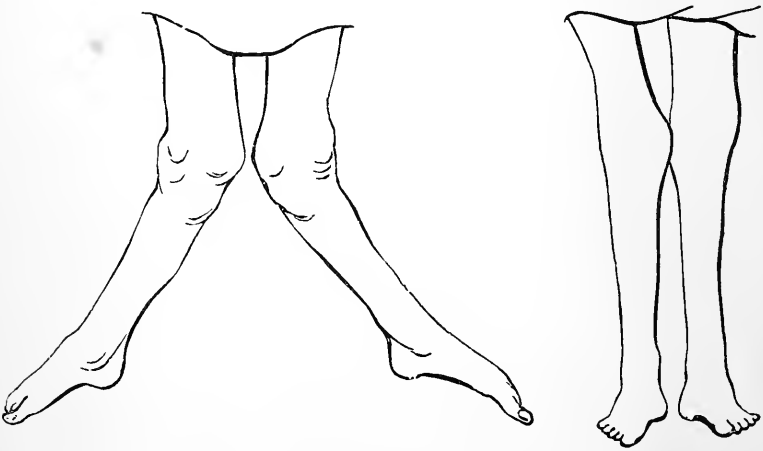
For anchylosis of elbow	4
For anchylosis of shoulders	2
For malunion of humerus	2
For rachitic curvature of humerus	1
For rachitic curvature of radius and ulna (2 cases), 3 osteotomies	3
For rachitic curvature of radius and ulna	3
	15
	plus 478
	493 osteotomies in all.

Epiphysial Chondrotomy.—Ollier of Lyons introduced this plan. It is based on the results of his experiments on the epiphyses of long bones.* He found that one can alter the growth, form, and direction of bones by excising the whole or part of the epiphysial cartilages, and he put the results of his experience into practice on the human subject with success. His operation was on the bones of the forearm and leg, in cases of inflammatory lengthening of one bone, or arrested development of one

* De l'excision des cartilages de conjugaison pour arrêter l'accroissement des os et rémedier à certaines difformités du squelette.—*Revue Mensuelle de Méd. et de Chirurgie*, 1877.

or other bone; but it may also be applicable to genu valgum or varum, though I know of no case in which it has been put into practice, and should think that the large incision necessary, and the time occupied in the operation, must be strong objections. Linear osteotomy is in every way preferable.

Osteoclasy.—This consists in breaking the bone or bones with a machine and without external wound. If a wound communicating with the bone can be done away



FIGS. 125 and 126.—Severe double genu valgum before and after diaphysial osteotomy.

with, and at the same time a good correction, without serious damage to the soft parts be obtained, this plan will supersede osteotomy. It is, like almost everything, an old method, and the osteoclasts of Hippocrates, Apelles, Archimedes, Paul of Ægina, and the more modern ones of Louvrier, Bosch, Æsterlen, Blasius, Rizzoli, Bruns, Volkmann, Esmarch, Collin, and Robin will be found figured and described in various ancient and modern surgical works and monographs. In pre-chloroform days the method must have been a brutal one, and even in more modern times it

has been rough and unsurgical, in that it lacked precision, and this is one great reason that osteotomy, as now performed, was preferred to it. The old methods of osteotomy with open wound were given up because of the bad results, until the subcutaneous plan was discovered; and it may be that the almost forgotten old plans of osteoclasy will be permanently revived and practised if good results be obtained. V. Robin has, during the last two years, rendered it more accurate, through the use of a new instrument constructed according to his own views, and has published* some excellent results on nine cases of genu valgum.† Mr. Schramm, the well-known orthopædic instrument maker of 64, Belmont Street, Chalk Farm Road, constructed for me an osteoclast, which appeared to be in every way preferable to previous ones, but as yet the instrument needs perfecting as our trials were not satisfactory.

Weak knees.—Surgeons in orthopædic practice are often consulted about this condition which consists in a feebleness and giving in of the knee on its inner side, and appears to be due to ligamentous laxity, and especially of the internal lateral ligament. If left uncorrected, an atonic genu valgum will result. The patients usually complain of discomfort, rather than pain, and inability to stand or walk for long. Such joints are usually felt to be looser than normal ones and are liable to severe sprains from any trivial accident. They are best treated by rest, massage, tonics, elastic knee-caps, or light instrumental supports.

* "Lyon Médical," 1882; also, "Traitement du Genu Valgum," &c., 1882.

† At the Copenhagen meeting of the International Medical Congress, Robin stated that nearly one hundred limbs had been successfully rectified by his instrument, which is superior to that of Colin.

CHAPTER XVII.

GENU VARUM AND CURVED TIBIÆ.

Definition.—This is the opposite condition to knock-knee, and consists in a greater or less separation between the thigh and leg bones when the subject of it is standing or lying with the limbs fully extended.

Synonyms. — Latin, *Genu Varum* or *Extrorsum;* Greek, *Exogonyacon;* English, *Bow-legs*, *Bandy-legged;* French, *Genou en dehors;* German, *Sabelbein*, *O-Bein*, *Sichelbein.*

Varieties.—It may be single or double, the latter being commoner, and usually one limb is more bowed than the other. The single form may be secondary to genu valgum, or valgum may follow on a primary varum, and be a result of the shortening of the varoid member, producing a compensatory inward or valgoid yielding of its fellow.

Causes.—These are the same as in genu valgum, but rickets is a much more frequent ætiological factor than an atonic condition of the muscles and ligaments.

Pathology.—Rickets, though a constitutional affection, affects chiefly the bones, and these often unequally, so that the spine and thorax may be deformed and the limbs remain free, or the tibiæ and fibulæ may be affected, and the thigh bones remain free, or the lower end of the femur, with or without the upper end of the tibia, may be diseased, producing genu valgum or varum; or the shafts of the long

bones may be affected, and genu varum, or curved leg bones, or both, may result. Not only may individual bones be attacked while others remain free, but the virulence or intensity of the pathological process may vary considerably, and this rachitic condition of the bones is the predisposing cause, whereas the body-weight in walking and standing produces the curvature, the direction of which will depend on (1) the part of the bone which is softest, (2) on the normal structure and curvature of the bone, it being naturally weaker at some points than others, and (3) on the direction through which the pressure is transmitted through them.

This deformity involves, usually, a larger area than does genu valgum, but the seat of greatest convexity is at or about the knee, which is thrown beyond the centre of gravity, so that a straight line from the middle of the femoral head to the centre of the ankle-joint would fall inside the knee, and the extent of the bowing depends not only on the amount of the deformity but also on the bone or bones affected, and on the portions of them which are deformed. It may be slight, or moderate, or it may nearly form a circle, and in the severest forms, which, fortunately, are rare, the leg bones may be at an acute angle to the femur and the feet may be crossed, or the patient may walk on the outer border of the foot and external malleolus. The feet are sometimes flat, and in severe cases one or both may be in a varoid state.

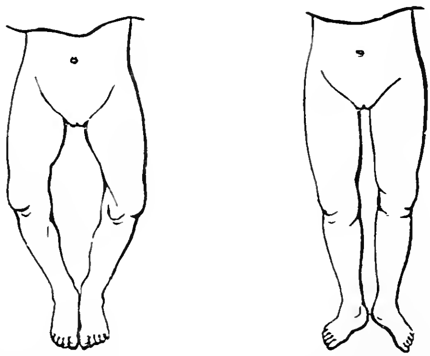
In cases where all the leg bones are affected there is a general outward curvature of the limb or limbs, but when situated at the lower end of the femur the greatest convexity is at the knee. The external condyle may be elongated and laterally enlarged, and the external tibial tuberosity also enlarged, and the external lateral ligament or tendon of the biceps elongated. In some cases, and

especially in rachitic ones, the joint line is oblique from within, down and out, and the ligaments loose. The lowering of the external condyle may be due to the outward curve at the lower end of the femur, or it may reside, as in the opposite deformity, largely, or in part, in the condyle itself. In some few cases the femur may be straight, but the leg bones bent and the knee ligaments lax.

If the bow be below the knee, which is a common condition, it may be due to a sharpish bend outwards of the shaft at its junction with the upper epiphysis, and in such cases a depression can readily be felt at this spot, and the overhanging inward projection of the internal tibial tuberosity can be clearly made out. In some few cases an abnormal spine may be felt at the outer side of the upper part of the tibia. A very common condition in this deformity is an outward curvature of the leg bones at their lower third, but this is not the most important factor in the production of bow-legs, though the deformity is aggravated by it. Seeing that the stress of the body-weight comes on the lower end of the tibia, which is between the point of resistance, *i.e.*, the foot, and the femur which transmits the weight from above, it would be more correct to say that the internal malleolus is pressed inwards, carrying the outer with it, and causing a curve or bend with its concavity inwards at the slenderest part of the tibia; but if this part resist, or have yielded, the next point of pressure-stress is at the upper part of the bones, and the angle already spoken of in this situation becomes formed. In cases where the whole deformity lies below the knee, the curve in the tibia may be near the middle or at either end, the upper being more commonly affected in true genu varum. If the femur, and upper and lower parts of the tibia be curved, as is sometimes the case, they, with the muscles covering them, not uncommonly give the appearance of a somewhat interrupted

single curve ; but sometimes there is one prominent curve, and the others, if present, are slight, and may be unnoticed, without careful examination. The tibiæ will often be found flattened laterally, producing the *platycnemic* tibiæ peculiar to some lower races. The fibula almost always shares in the deformity.

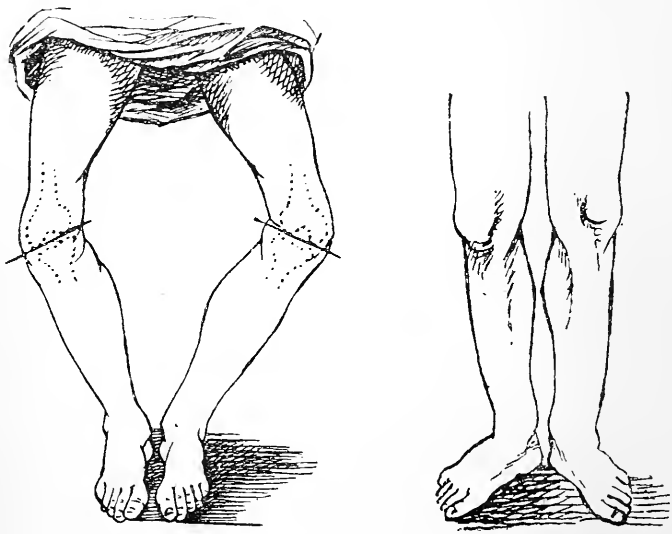
Genu varum of one side and valgum of the other may occur in the same individual, though this condition is not nearly so common as double varum or valgum. In such cases there may be pelvic or spinal deformity, which, however, is not usually very marked in young people. Sometimes, in operating on these cases, one femur may be found harder than the other, and one curve, whether in or out, is generally *secondary* or *complimentary* to the other. If the changes in these cases be confined to the femur, it must be recollected that changes in the length and obliquity of the femoral neck may considerably aid in producing the deformity.



FIGS. 127 and 128.—Genu extrorsum in a girl aged nine, before and after diaphysial osteotomy.

Symptoms.—The altered height of the individual, and the peculiarity of the aspect and gait of the patient are noteworthy, and it will generally be found in cases of the

combined form, *i.e.*, valgum and varum, that the subject walks more firmly and steadily on the bowed leg than on the valgoid. Both deformities disappear in complete flexion. In many cases of rickety genu varum the external condyles will be found lower down than the inner, and the joint oblique from within, down and out. The explanation of the disappearance of the deformity is similar to that given in the chapter on genu valgum.



FIGS. 129 and 130.—Severe genu varum in a young man aged ninteen, before and after external condylotomy. The oblique position of the joint is shown.

Treatment.—In the first and second stages of the rachitic deformity, which is commonest, removing the body-weight, and the use of suitable lateral splints or apparatus, may, in young subjects, correct the deformity, but I have too often found that even in children of three to four years of age, this treatment is of no avail. I always adopt it, however, as a routine practice before resorting to osteotomy. In moderate cases it will be sufficient to divide the femur

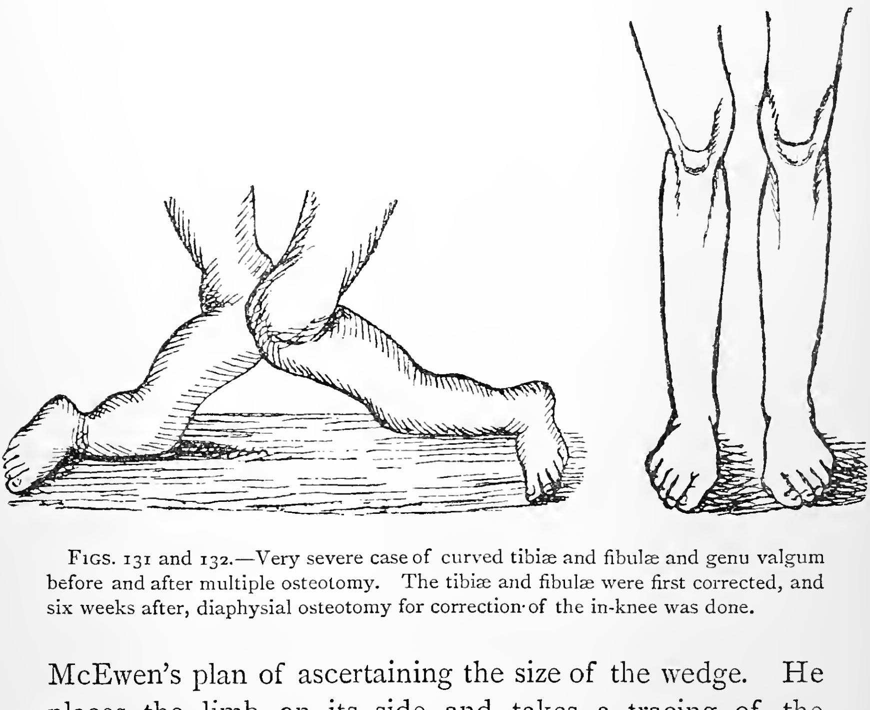
at its lower third, but if the tibiæ be also much curved these will have to be subsequently, or simultaneously, corrected. If the external condyle be much elongated, external condylotomy, I have found, to thoroughly correct the deformity.

CURVED TIBIA AND FIBULA.

These, as met with in orthopædic practice, are almost always due to rickets, and are commonly met with before the age of five. If unchecked, they may go on increasing in severity, or they may remain stationary for a time and then subsequently increase. The direction and position of the curve varies in different cases. It is commonest at the lower third of the leg bones, and as an outward deviation, but there may be a simple anterior curvature, or an antero-external. Rarer forms are the antero-internal, a severe instance of which, combined with genu valgum, is shown in an ensuing figure. The tibiæ in many cases are found compressed or flattened from side to side, resembling the *platycnemic* tibiæ of some lower races. The fibulæ usually assume the same curve, but in some exceptional cases they remain straight. In severe cases of antero-internal curvature, where the body-weight is to a great extent borne by the bent bone, bursæ may form and may inflame and suppurate. In some instances, the entire tibia is bent anteriorly or antero-laterally, and the tendo-Achillis much shortened. The foot may be either in a valgoid or varoid position.

Treatment.—In early stages, removal of the body-weight and the application of properly fitting splints of various materials are of service, but generally, the deformity is set when the surgeon sees the case, so that osteotomy or osteoclasy, are the only means of effecting correction of the curvature. I have, in most cases, found that a simple

linear osteotomy from before backwards, with division of the tendo Achillis, if necessary, is sufficient to correct, or to very much improve, the deformity, and this latter result I prefer to adopting cuneiform osteotomy, which involves a larger operation, and a much longer convalescence. In some severe cases it may be necessary to remove a wedge of bone, and as it is desirable only to remove as much bone as is necessary to correct the curvature, it will be well to adopt



FIGS. 131 and 132.—Very severe case of curved tibiæ and fibulæ and genu valgum before and after multiple osteotomy. The tibiæ and fibulæ were first corrected, and six weeks after, diaphysial osteotomy for correction of the in-knee was done.

McEwen's plan of ascertaining the size of the wedge. He places the limb on its side and takes a tracing of the anterior border of the tibia, then he measures the breadth of this bone from before backwards at the most prominent part of the convexity, and draws a second line parallel to the former, and corresponding to the breadth measured; the shape is then cut out, and the paper folded at the most prominent part of the convexity. The fold has to be

wedge-shaped, with its base anteriorly, and it should be altered until the pattern has become straight. The base of the wedge will represent the size of the cuneiform portion to be removed, then the distance is marked and fixed on a pair of callipers, which may be applied to the bone, if necessary. An incision sufficiently long to admit the finger and callipers is to be made, and the wedge removed by means of a chisel, and not an osteotome. The chisel should have a clean cutting edge and be bevelled. A wedge smaller than that required should be first removed, and then from either side extra shavings may be taken to the necessary extent. The bony incisions on each side should be perfectly smooth. The periosteum should be raised from the bone before applying the chisel, not only to ensure more complete filling up of the gap, but also to protect the neighbouring soft parts. When the wedge has been removed, and the wound cleansed from all bony fragments, the fibula may be broken, if possible, or osteotomized, when the limb must be put in position and, if necessary, the tendo-Achillis divided. In placing the anterior surfaces together, care must be taken not to include muscles between the bones, as this may result in non-union, or suppuration. St. Germain has recently devised an osteotome which will remove a wedge of various sizes, and more accurately than can be done by the use of an ordinary chisel. In the rarer cases of *twisted* tibiæ it may be necessary to do an oblique osteotomy, either down, or in, or from before, backwards, or even, to do more than one osteotomy, before the limb can be straightened. The after-treatment is the same as for compound fracture.

CHAPTER XVIII.

CONGENITAL MISPLACEMENTS AND DEFICIENCIES OF THE LOWER LIMB.

Congenital Malpositions of the Hip.

Of all congenital displacements this is the commonest, and it is to be considered rather as a joint *malformation* than a dislocation proper. This deformity has been termed *congenital dislocation*, but as, in the majority of cases, there originally was no complete contact between the joint surfaces, the term "dislocation" is quite inapplicable.

Definition.—This malady consists in certain conditions which cause an abnormality of position between the femoral and acetabular surfaces, one, or both of which, are insufficiently developed. The ligaments of the joints are usually abnormal.

Varieties.—There may be a true form of coxal *dislocation* due to the accoucheur's efforts to turn, or deliver, during childbirth; but the forms of congenital *malposition* are various, and depend upon conditions which will be explained in the paragraph on pathology. It may be *single*, or *double*, the latter being the commoner, and is much more frequent in girls than in boys, though I know of no very satisfactory explanation of either of these occurrences. The displacement up and back on to the dorsum ilii is by far the commonest, though the up and forwards or ilio-pubic,

and the upwards or supra-cotyloid displacements, do occur, but are usually associated with conditions, such as monstrosity, which do not admit of treatment. There is a class of congenital *partial* dislocations, or sub-luxations, which is commonly associated with idiocy or paralysis. These may often be reduced without great difficulty, but owing to the general conditions just mentioned, the surgeon's efforts are of little avail.

Causes and Pathogenesis.—Many hypotheses have been

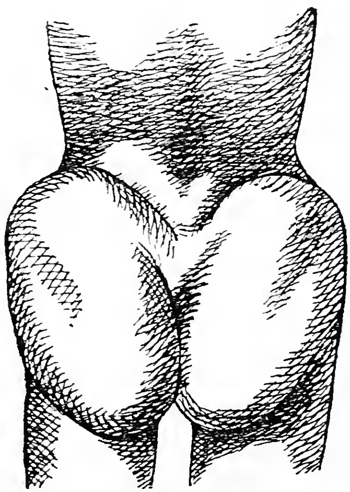


FIG. 133.—Congenital double hip displacement in a young woman seen from behind.

offered in explanation of the occurrence of this deformity. Some attribute it to maternal impression, others to defective development, or to a bad intra-uterine position of the fœtus, which may be independent of, or concomitant with, an abnormal narrowness of the uterus, cramped by the presence of twins or triplets, or it may be due to efforts at extraction during birth. Dupuytren* thought that the hip capsule was too long in these cases, permitting of ready displace-

* "Leçons Orales de Clinique Chirurgicale."

ment. Breschet considered that the head of the femur is at fault, being insufficiently developed or absent, and thus easily displaced. Volkmann and Broca attribute it to the articular surfaces not being developed opposite each other, and thus not permitting of proper apposition, and the latter eminent surgeon also thought that a defect in nutrition and local ossification, was the cause of the deformity.

Hippocrates, Dupuytren, and Cruveilhier were all of opinion that this deformity is caused by an abnormal position of the fœtus in utero; and Roser thought that this incorrect position of the fœtus caused excessive adduction of one or both femora, and thus produced the deformity. Others have thought that it may be due to the gradual pressure of the mother's clothes, or stays, or by the sudden pressure or shock, of blows or falls. Guérin, Carnochin, and others have ascribed it to muscular retraction associated with pathological conditions of the nervous system; and others, my colleague, Mr. Brodhurst, among them, to a purely mechanical cause, *i.e.*, to the "downward force applied to the thigh in endeavouring to hasten the birth in breach presentations."* Verneuil, and Dally concurring with him, regard some of these cases as not being really congenital, but as being produced after birth by a paralytic atrophy of the hip muscles, and especially of the gluteals, as the result of infantile paralysis. Sayre† attributes the malformation entirely to deficiency of development of the acetabulum, though he does not give any pathological evidence of this being the sole cause. Intra-uterine disease of the joint, looseness of the coxo-femoral ligaments (Sédillot), arthritis, and hydrarthrosis, have also been regarded as causes, in individual cases. Having had the opportunity of

* "Lectures on Orthopædic Surgery," Second Edition, p. 160. London, 1876.

† "Lectures on Orthopædic Surgery," p. 344. London, 1876.

seeing a large number of these cases in my practice at the Royal Orthopædic Hospital, and in that of the London Hospital, and the East London Children's Hospital, during many years past, and having been much interested in them, I have made careful examinations, and have also diligently studied the accounts of dissections which have been made, of cases in which a post-mortem was obtained. I have thus been led to adopt an eclectic conclusion, viz., that different cases have a different ætiology ; and I am at present inclined to regard defective development as the commonest cause, and mechanical force in delivery as not very frequent,

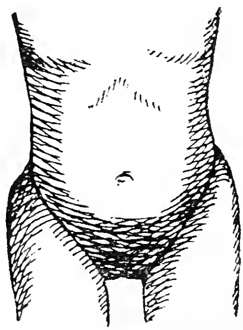


FIG. 134.—Right congenital hip malposition. Anterior view.

though I do not deny that any of the other named causes may be active in particular cases, or that more than one cause may be at work in any individual instance.

In cases of defective development, the fault may reside in the acetabular part of the os innominatum, and then it can only be satisfactorily made out after dissection; but I have been able to detect abnormality in the head of the femur, in several cases, during life, and in others it has apparently been normal. When affected, the head is usually atrophied, but may be hypertrophied, the latter appearing to be, in my experience, not very uncommon, and I imagine

this is due to the difficulty the misplaced bone is subjected to in muscular efforts to accommodate itself to its altered position, and to carve out a new acetabulum. The irritation and friction consequent on this leads to increased activity of growth, and thus results, hypertrophy of the femoral head. In defective development, the bony or ligamentous parts of the joint are usually primarily at fault, and muscular contraction and shortening are secondary. Three conditions may be present, either singly, or more or less combined, viz., 1, incomplete formation of the acetabulum, or ossification of the os innominatum may be normal; 2, the joint surfaces may not be *vis-à-vis* to each other; or, 3, the ligaments may be lax or deficient, and permit of ready displacement of the femoral head, through muscular action, or other force.

I cannot doubt, however, that efforts at delivery have produced hip dislocations; and in one case I know of, fracture of the thigh was thus produced. But, judging from my own cases, and from others I have read or heard of, I cannot agree with my colleague, Mr. Brodhurst, when he says, "The cause of congenital dislocation of the hip, as it usually presents itself, is a purely mechanical one. This dislocation never occurs except after preternatural labour, and it occurs especially with the presentation of the nates," because I have made special inquiries as to this point, and in many of the cases have failed to elicit any difficulty in childbirth necessitating unusual manual or instrumental aid. C. Hueter* is also of this opinion, and he denies that a traumatic dislocation can occur at this period of life, but in this statement I cannot agree with him. These *obstetric dislocations*, accompanied as they must be by laceration of the ligaments, are traumatic luxations rather than what is ordinarly understood as congenital displacment.

* "Klinik der Glenkkrankheiten," Erster Theil, p. 326. 1876.

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As regards Verneuil's theory, that the displacement is in several cases secondary to paralysis of the circumcoxal muscles, my experience leads me to concur that paralysis may lead to dislocation of the hip; but this is quite exceptional. As I speak of this subject further on in this

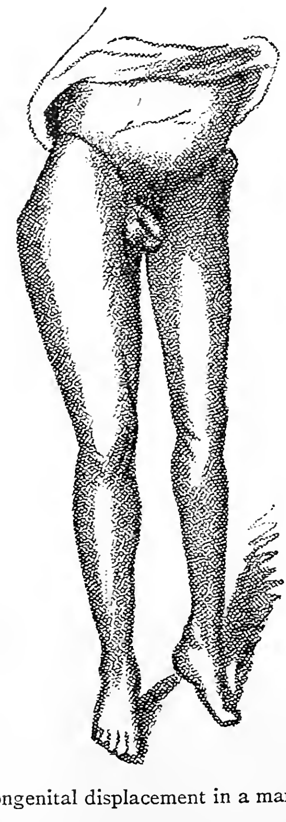


FIG. 135.—Left congenital displacement in a man aged twenty-nine.

volume, I need only here remark that congenital paralytic luxation I have never seen; and it must be recollected that attention is usually only drawn to the deformity after the child has begun to walk, so that if paralysis pre-existed, progression without aid would either be impossible, or would be of a character so different from the rolling gait of

congenital malposition, that there should be no diagnostic difficulty. Guérin and Carnochin's view of active muscular spasmodic retraction, as causing, not only congenital dislocations, but all other congenital articular deformities, cannot be borne out by the facts, as, excepting these writers, no one else seems to have met with this muscular affection. I would not deny that spasmodic muscular hip-contraction may be congenital, for I have seen it, though I have never seen it as a cause of congenital hip displacement; and though I doubt not that the muscles may, and do, become secondarily shortened, and more or less rigid, and ultimately wasted, still I cannot, from my own experience, assert that they are primarily contracted, or that they cause the deformity by their abnormal action, independently of any articular or ligamentous deformity.

Heredity seems to play a somewhat important productive part in some instances of congenital hip misplacements, as in other deformities; but in most of the cases I have seen, the deformity, whether single or double, was uncomplicated with such history, or with other malformations. Brodhurst* saw three children of one family, one had the right femur displaced, another, the left, and also pes varus, and the third, had both bones displaced. The sex is not given.

Vallette considers that hereditary influence explains the relative frequency of this deformity in certain parts of the world, for it is rare in the north of France, but is much more frequent in the upper regions of the river Loire. I have seen two cases, occurring in girls, one of which was sent to me by my colleague at the East London Children's Hospital, Dr. Eustace Smith, in which the mother was similarly affected. In one case, parent and child had double dislocation, in the other, the mother had single, and

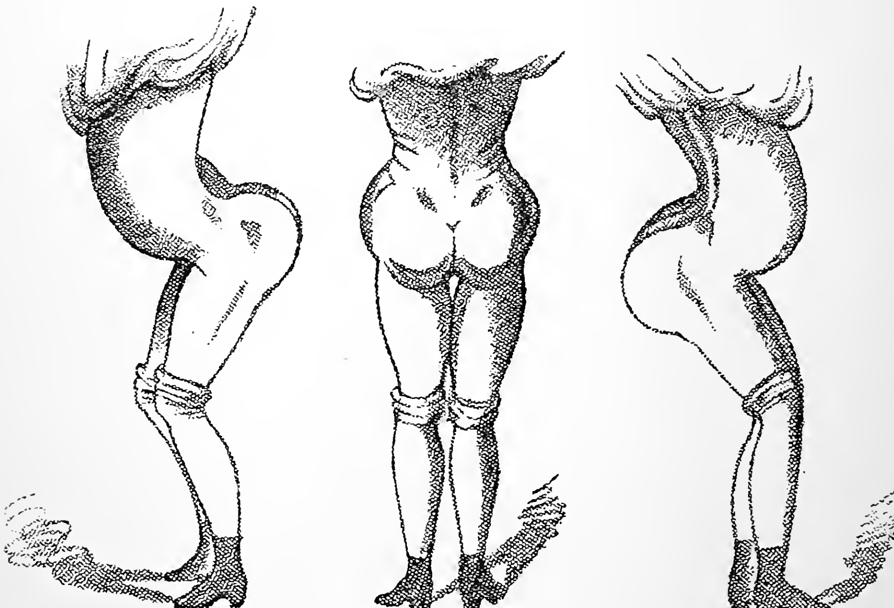
* *Op. cit.*, p. 161.

the child double displacement. Tillmann* came to the conclusion, from a dissection which he made, that this malformation was due to a very strongly developed ligamentum teres, which dragged the head of the femur out of place. It may be, that during development, a very strongly developed ligamentum teres may have this effect; but ligaments are more passive than active, and I cannot readily understand Tillmann's explanation, unless bony deformity, or muscular action were superadded. Moreover, bearing in mind the attachment of this ligament, if it were active, it would tend to displace the head of the bone down, instead of upwards. The explanation of this deformity, like that of others, and of its greater frequency on both sides than on one, may probably be that there is some central median deficiency, or even disease, in the spinal cord; or some error in the vascular supply, which is incompatible with complete development. In the case of single malformation, the nervous or vascular lesions would probably be unilateral. Sex is undoubtedly a *predisposing cause*, as this affection is much more common in girls than in boys, though the infantile and juvenile pelvis is but slightly different in the two sexes. At present, I know of no satisfactory explanation of this occurrence.

The case of left deformity, shown in the last figure, died in the London Hospital. He was admitted for ulceration of the rectum and diarrhœa. This and the laryngeal affection, which killed him, were syphilitic. He was a West Indian sailor and was in the hospital a year before under Mr. Jonathan Hutchinson, who wished to excise the joint under the belief that the case was one of traumatic dislocation, the man having fallen, but falls were not uncommon with him, and were due to the weakness of the limb. Mr. Lipscombe, the house surgeon, and I dissected the limb,

* "Arch. der Heilkunde," B. XVI. 1873.

and found that the head of the femur was very rudimentary and nodulated, and the neck short. There was no acetabulum, but a projection in its place, which was quite solid. Above this, there was a slight depression on the dorsum ilii, with irregular cartilaginous deposit, forming an incomplete socket. There was no ligamentum teres, and the femur



FIGS. 136, 137, and 138.—Posterior and right and left profile views of a case of congenital hip displacement in a girl. The lordosis and prominent abdomen, are well shown.

was kept loosely in place by the gluteal muscles over it, which, with a little thickened fascia, acted as the joint capsule.

Symptoms.—These will vary according as the lesion be uni- or bi-lateral, and as the latter is more common, I will first consider the symptoms produced by it. In double deformity, the gait is characteristic, the patient, in walking,

rolls from side to side, balancing and raising herself or himself, on the anterior and lower part of the feet, and inclining the upper part of the trunk—which is usually held backwards—to that member which is sustaining the body-weight. In running, the subject rolls less than in walking, because the more energetic contraction of the hip muscles fixes the femoral heads more tightly in their sockets, and thus allows the body to be held more upright. Young children hold up their arms in order to balance themselves. The trochanter of the side on which the body rests in progression ascends towards the iliac crest, either because the muscles and ligaments which unite the femur to the innominate bone yield directly the body-weight rests on the limb in use, or because the iliac expansion is at a greater inclination on that side, through the peculiarity of gait. In fact, in single and in double misplacements, the anatomical peculiarities of this deformity are increased, or exaggerated, when the patient is standing, walking, or running. Anatomical examination reveals that the femoral head cannot be felt through the groin; that the great trochanters are much above the Roser-Nélaton test-line, *i.e.*, from the anterior superior iliac crest to the lower part of the tuber ischii; that they are unduly prominent, as well as higher, than natural; and that the femoral head, if present, projects beneath the glutei, usually above and behind the cotyloid cavity, and may readily be felt on rotation, which elicits a masked or cartilaginous crepitus, that may be heard and felt; and if the limb be flexed and extended, it will be observed that the head of the femur describes arcs of a circle. The femora are not infrequently on different levels on the two sides, which may be due either to the different extent of the deformity, or to varying muscular action, or to the habit of standing more on one leg than on the other, thus pushing it more up on the more used side.

The lower limbs are more or less flexed either at the hips, or knees—which latter are usually in slight valgus, owing to the upper ends of the femora being more separated than usual; and, not infrequently, there co-exists pes valgus, which is secondary to the change of axis of the limb. The trunk has a length quite disproportionate to that of the limbs, appearing much longer than normal, and the limbs shorter. As a result of this apparent shortening of the thighs, the ends of the fingers correspond to the external condyles, or may even pass below them, whilst in well-formed children, the fingers only reach the junction of the middle and lower femoral-thirds. The muscles of the lower limb are ill-developed, from insufficient use, although subjects of this deformity are fairly active and can get about for moderate distances without pain, though they are somewhat easily tired. In the recumbent position, the pelvis being fixed, the limbs may usually be drawn down to their proper length, but relapse as soon as the extending force is withdrawn. Passive, as well as active motion, show that the movements of the joint are free, with the exception of abduction, which is limited, adduction being increased. The abdomen is strongly curved forwards, the thighs at their upper and inner parts are separated, and pass obliquely down and in, while the legs pass in a contrary direction. The pelvis is rendered very oblique, the pubis being carried down and forwards, and the sacrum raised, while the lumbar and lower dorsal vertebræ are curved forwards, causing an extreme lordosis, and increasing

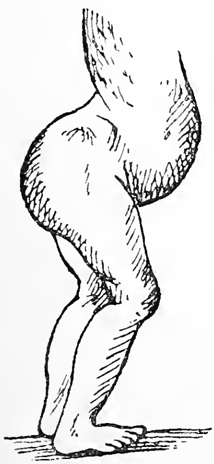


Fig. 139.—Congenital malposition of right hip in an infant. Right profile view.

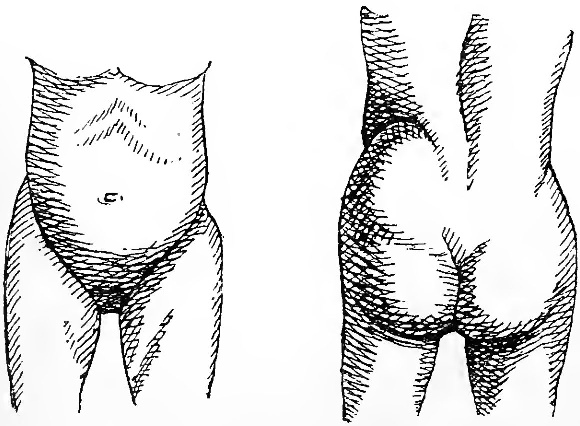
the abdominal prominence. This lordosis is very marked in dorsal decubitus, though in some cases it is considerably diminished. The distance between the anterior superior iliac spines and the symphisis, is shorter than natural, and the gluteal folds are much less marked than normal, though the buttocks are elevated and project strongly when standing. The breadth of the hips is increased owing to the projection of the great trochanters. If, in infants and young children, the finger be passed into the rectum a fissure may, in some cases, be detected in the os innominatum at the seat of the acetabulum.

On examining the patient from behind, a well-marked lumbar lordosis will be observed, and sometimes this is so extreme as to form an angle, instead of a curve. The spinal muscles are often atrophied, the great trochanters will be found raised and usually placed more posteriorly than normal, and this deformity is generally more marked on one side than on the other. In profile, the limb position, the spinal curve, and the protuberant abdomen, will be more noticeable, and inclination of the pelvis down and forwards will be found to exist, the object of which is to establish equilibrium in standing. The pelvic inclination, and the lordosis, will become more evident if the child be placed upon its back, and it will be found that the movements of the limb, with the exception of abduction, are preserved. In many cases, the patient cannot flex the leg so as to bring the thigh in contact with the abdomen. If strong abduction be voluntarily, or passively, attempted, the opposite side of the pelvis will be raised, and turned towards the moving side. The adductors are almost always contracted. In most cases, the fingers placed in the groin will fail to find the femoral head on movement. If the pelvis be fixed, and the affected limbs be drawn on, they can, as already stated, be elongated, and when relaxed, the

upper portion of the bone will rise, so that the trochanters are very nearly on a level with the iliac crest, or only slightly below it.

In *unilateral* displacement, the walk assumes a different aspect, and is more of an oscillating nature, so that when the foot touches the ground, the trunk is drawn to the same side, the thigh appears, as it were, driven into the pelvis, and the hip is lower than the opposite one. The malformed limb is shorter and more slender than its neighbour, and directed inwards, and the lumbar spine is inclined towards the opposite side, so as to bring the centre of gravity in its proper position. In unilateral displacement, secondary malformations of the pelvis, which are of importance obstetrically, are produced. In double deformity the antero-posterior pelvic diameter is greater than natural, and labour is easy, but in unilateral, the ilium is pushed towards the opposite side, and modifications of the superior outlet are produced. Naegele, Guéniot, Verrier, and Champneys, have drawn attention to these secondary pelvic deformities. Some of these patients walk in equinus on the affected side, others walk on the entire sole and flex the knee of the sound side, and in such cases the peculiarity in walking is more noticeable. In nearly all cases the pelvis on the malformed side is placed more anteriorly in walking, and the knee of this side often touches the opposite one, and tends to cross it. While running, the peculiarity of gait is less noticeable, because the muscles are more energetically contracted and fixed to the femoral head. If the patient be lying, the affected limb will be shorter than its neighbour, there will be a hollow in the groin, the trochanter will be higher than the Roser-Nélaton test-line, the remains of the femoral head will be felt beneath the atrophied muscles and the ilium, in the commonest form of dislocation, and a peculiar crepitation, or friction sound, will be felt.

in most cases, during flexion, extension, and rotation; and it will be found that the femoral head, or its remains, if present, will describe arcs of a circle. The anterior superior iliac spine of the affected side will be found on measurement nearer the symphysis pubis than on the opposite, the gluteal fold is higher and less marked, and there will be some prominence in the corresponding iliac fossa, due to its having been bulged forwards and inwards during growth, by the displaced head of the femur. Adduction will be increased, abduction diminished. The foot may be in various



FIGS. 140 and 141.—Left congenital hip malposition. Anterior and posterior views.

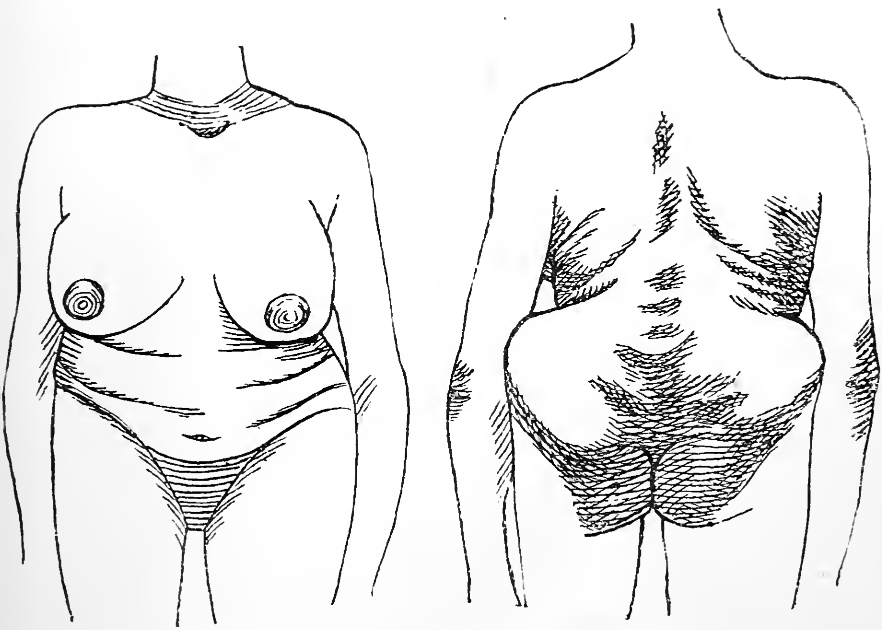
positions, inverted, straight, or turned outwards, and I have observed that these are valuable signs in diagnosing the presence or absence of the femoral head or neck, for when these are present inversion is the rule, when absent eversion exists. Extension increases the length of the displaced limb, but never makes it equal to the opposite one. The lumbar spine is convex anteriorly and to the luxated side.

Complications.—Neuralgic pains along the sciatic or the anterior crural are sometimes complained of, and may be due to stretching or compression of these nerves. The new false joints may spontaneously, or after a fall, inflame,

and may lead to diagnostic mistakes, such as confounding it for pathological dislocation; and in cases coming under care later in life, it may be thought that dislocation has occurred, and if the crepitation, already mentioned, co-exist, the case may be confounded with one of fracture and dorsal dislocation.

Diagnosis.—This is usually not difficult, if the patient be seen within a year or two of its first walking; but in infants, and in some cases which have been overlooked, or passed unobserved until a later period of life, certain difficulties may arise. In infants, by accurate measurements and manipulations, this deformity may be made out, but usually the existence of any abnormality is not noticed until the child begins to walk, and then the question arises between joint mischief and infantile paralysis, which latter may occur during the early months of existence; but even in such cases, it is rarely that the surgeon's attention is drawn to them until the child has attempted to walk, when the parents, noticing the peculiarity, bring it for treatment. It is usually easy to differentiate it from morbus coxæ, and careful examination will diagnose it from paralysis. In some cases of single dislocation the child cannot walk without support, and then the peculiar gait may disappear. In cases occurring later in life, the history and the presence of a similar deformity in the parents, and especially in the mother, will be of service in distinguishing it from pathological or traumatic dislocations. But the latter are so rare in children that they may almost be dismissed from consideration, though separation of the epiphysis of the head of the femur, or epiphysitis of the head or great trochanter, may and do occur, and may give rise to diagnostic difficulty. The absence of pain at the hip or knee, and on communicated movement, and the absence of enlarged inguinal glands, will serve to distinguish it from hip

disease. Mr. Holmes, in his work upon "Diseases of Children," correctly says, that in congenital luxation the shortening may disappear of itself, or after a slight extension, and that voluntary or communicated movements are easy, rapid, and without pain, and that whatever position be given to the limb, one may follow, easily, the movements of the displaced bone.



FIGS. 142 and 143.—Double congenital hip malposition in a woman who had had children. Seen from the front and behind.

If the patient be seen between five or ten years of age, or later, the parents will have observed its peculiar walk, and also that the child often falls about. In such cases, difficulty will only arise in unilateral lesion, then the question will be between coxitis, diastasis of the epiphysis of the head of the femur, and traumatic or paralytic dislocation; but careful examination will suffice to diagnose

between these affections. If, on the other hand, the child has walked fairly well, and it has lately become feverish and kept its bed, and then more or less lost its power of motion, and walked with a limp, the question will be between coxitis and paralytic dislocation; but the existence of paralysis will be enough to distinguish between these affections. Hysteria, or malingering, which is not uncommon in children, and especially in young girls, may give rise to doubt as to the nature of the affection, but the ordinary tests for this malady will help us in clearing up doubts. Other sources of difficulty have been given in the paragraph on complications.

Prognosis.—This varies according as we regard it from the prospect of alleviation or cure. There is never any risk to life, except such as may accrue from the instability of the patient leading to accidents. Unilateral displacement leads to pelvic deformity, which may more or less seriously complicate childbirth, and thus the prognosis may become of life-importance in these subjects, though even in them the deformity is not often of very serious import. As already pointed out, the capsule becomes elongated and hypertrophied until it has reached its limits of extension, so that it then remains *in statu.* It should be borne in mind that a severe accident may thrust the upper part of the bone through the capsule, and so lead to the idea of a dorsal dislocation, unless the previous history of the case be known.

Treatment.—This is *palliative* and *curative*, but if the patient be beyond puberty, there is little to be done beyond relieving the deformity. My opinion is, that in the large majority of cases, anything other than palliative measures, such as the use of appropriate apparatus for grasping the trochanters, and keeping them as far as possible in place, is of little use. Pravaz claimed to have made cures by the

use of his special apparatus, but Bouvier, and others, have fairly shown that these were not permanent cures. As regards operative measures for the relief, or cure, of this deformity, I can say nothing from personal experience, and seeing that the pathological conditions differ more or less in almost every case, I can expect little from any proceedings yet devised in the way of making a firmer and stronger

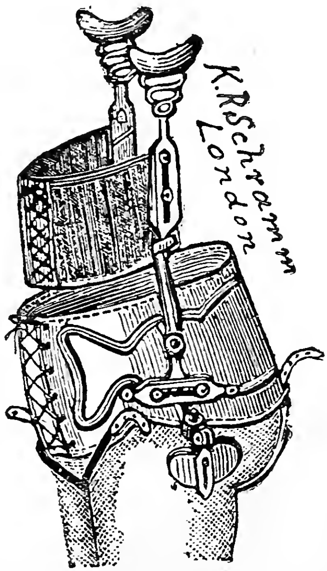


FIG. 144.—Instrument for double congenital hip displacement.

joint. Mr. Brodhurst records a case in which, after consultation with Mr. T. Holmes, he divided the tendons attached to the great trochanter with considerable benefit. Though I have seen quite a large number of these deformities, I have never felt that I could offer any hope of permanent relief by any operation which I could devise, or which I have read of, so that I have been content either to leave the deformity to itself, or to apply appropriate

mechanical apparatus. These, if properly measured for, and regularly worn, may, in the case of young children, do a good deal to prevent the elongation of the capsule, and the further displacement of the bone towards the iliac crest.

I may here mention that, in some cases of fissure of the abdominal wall, the femoral head is found displaced, and the vesical distension, which is a very likely cause of the non-union of the abdominal wall, causes separation of the pubic rami, and the altered direction and imperfect growth of the pelvic bones, cause shallowness of the acetabulum and consequent slipping out of the femoral head.

Lumbo-sacral *spondylolisthesis* may cause diagnostic difficulty, as some of the symptoms, especially the lordosis, are similar. Valuable papers on this subject have been written by Neugebauer and Swedelni,* and the last volume of the Transactions of the Obstetrical Society contains a good paper on the subject.

* *Archiv für Gynäkologie*, B. xxii. H. 11, and abstract in *Medical Times*, September 6, 1884, p. 333.

CHAPTER XIX.

DEFORMITIES OF THE TOES.

Causes.—These are very rarely *congenital*, and the *acquired* forms are generally the result of muscular or fascial contractions, or are due to mechanical causes, and though of less importance than similar affections of the fingers, are, nevertheless, entirely worthy of the surgeon's attention on account of the hindrance to progression which they so commonly produce. The prime cause may be mechanical, and the muscular and ligamentous retraction secondary. Scars of burns, diseases of the bones and joints, gout, rheumatism, and the various forms of dactylitis, and paralysis, may produce them; but we shall here specially deal with those affections which commonly come under the observation of the orthopædic surgeon.

Varieties.—The toes may be displaced *transversely*, or *vertically*, the former being the more common, and the big and little toes being usually affected, more especially the former, which condition is known as *Hallux valgus.* The great toe may also be drawn toward the mid-line of the body, and separated from its fellows: this is termed *Hallux varus* or *Pigeon-toe*, and is sometimes an independent affection, and at others associated with talipes varus. The great toe may over- or under-lie its neighbours, when the affection may be termed *Over-toe* or *Under-toe.* In vertical contractions, the bulb of the last phalanx, and sometimes

the nail itself, rests upon the ground. This condition is known as *Hammer-toe.*

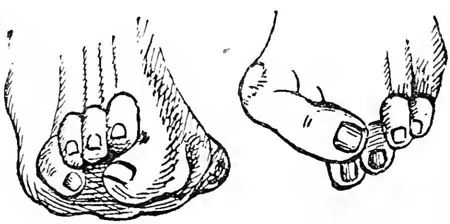
TRANSVERSE DISPLACEMENT OF THE TOES.

Hallux valgus. Symptoms.—The patient complains of difficulty in walking, and pain, usually at the seat of the metatarso-phalangeal articulation, and sometimes of cramps of the foot, occurring chiefly at night. The toes may perspire freely in the inter-spaces, and corns and bunions over the metatarso-phalangeal joint complicate the affection. On examination, the great toe will usually be found displaced outwards at a varying angle, overlapping the second, and part of the third toe. In rarer cases, it is on the inferior or plantar aspect of these. Similar malpositions may affect the little, and sometimes the other toes. *Hammer-toe* sometimes complicates these cases, as an accommodative effort of the neighbouring toes, to make room for the great toe.

Causes.—This transverse deviation of the toes, and especially the outer deviation of the great toe, has been attributed to the pressure of improperly made boots. Camper states, that during standing and walking, the tarsal arch flattens and the foot elongates, so that the heel is pushed backwards, and the toes forwards. If the boots be sufficiently long and broad, the toes are properly accommodated, but if they be short, the toes are pushed obliquely backwards, and the big toe, being generally the longest, is the first to become deviated, and as the boot will not allow it to be turned inwards, it is turned outwards over the other toes, because the boot-sole and the upper leather, in most cases, prevent its being displaced beneath its neighbours. The other toes crowd one upon the other and converge towards the axis of the foot, which is through the second

metatarsal bone, and form two layers, one dorsal and one plantar.

Malgaigne does not accept this view, but explains the deformity through muscular retraction, the effect of rheumatism and gout, and to the influence of the bursæ, and the enfeeblement of the internal lateral ligament. Dubreuil believes in muscular contraction or retraction, secondary to the pressure of the shoes, or other causes, excepting the diatheses, which act directly through the muscles; and if we consider that were the cause always a badly fitting boot, one should meet more frequently with the deformity among



FIGS. 145 and 146.—To left, is transverse deviation of right great and little toes with hammer-toes and bunions; to the right, the left great toe overrides its neighbours.

the well-to-do, than among the poor, who do not study the shape of the boot so long as they are able to walk comfortably. But this deformity is often seen in the post-mortem and dissecting-room; and though it may be said that we should find it equally, if not more frequently, among the middle and upper classes if post-mortems were as frequent in them, still there can be no doubt of its commonness among the poor, who, as a rule, do not wear tightly fitting boots for the greater part of the day.

Moreover, if one reflect as to what should be the resultant action of muscles which move the great toe, and if one compare its abductors and adductors (to the mid-line of

the body), the predominance of the former will be evident, for it has the extensor proprius and flexor longus hallucis, the innermost tendon of the dorsalis pedis, the transverse hallucis, and the adductor, (which is an abductor from the mid-body-line) all as abductors; whereas it has but one muscle to draw it to the median body-line, the abductor hallucis, which is more a flexor than an adductor. In standing, in consequence of the predominance and normal tonicity of these abductors, the great toe has a tendency to incline outwards, and the more the muscles act, the more the abductors overcome the adductor, and the outer deviation of the toe will become more manifest; and among the poorer working classes, the increased use of these muscles, which their calling commonly necessitates, will probably explain the greater frequency of this deformity among them.

The arrangement of the muscles of the little toe, which has a long flexor, which also adducts it to the mid-line of the body, and an extensor tendon, which has a similar effect, to counterbalance the abductor minimi-digiti, permits the *inward* displacement of this tendon to be explained on muscular grounds, and the shape of the boot, moreover, would tend to facilitate this displacement of it, as well as the outer displacement of the great toe. The intermediate toes may be laterally displaced, but these are consecutive to those of the outer and inner toes, so that there can be no doubt that muscular action is, at any rate, a powerful *predisposing* cause; but I think that most often the *exciting* cause resides in improperly constructed boots.

Pathology.—Broca first accurately studied these deviations with special reference to the great toe. I have had the opportunity of dissecting several of these, and can vouch for the accuracy of his paper. The head of the first metatarsal, which has for sometime ceased to be covered at its inner part by the base of the first phalanx, is deprived

of cartilage in that part which is not in contact with the phalanx. The internal lateral ligament is much elongated, and the anterior end of the metatarsal bone is drawn inward, while the phalanges are drawn outwards ; the metatarsal also undergoes a rotation on its axis from above and out, downward and inwards. A serous bursa becomes developed over the inner part of the metatarso-phalangeal joint through the friction of the shoes, and this leads to a thickening of the skin and callosity, and sometimes to a

FIG. 147.—Apparatus to correct transverse deviation of great toe.

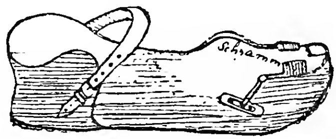


FIG. 148.—Sandal with cog-wheel and key for hallux varus.

corn forming over a bunion, of which the bursa is the centre. This bursa may communicate with the cavity of the joint in some cases, and should it inflame, it may lead to articular destruction. From continued pressure and irritation, the nerves of this part are very sensitive and hypertrophied, and, through unequal pressure on the last phalanx, ingrowing toe-nail, or onychia, may result, or hypertrophy of the nail ; and these are commonest among those who are not cleanly with their feet, and who neglect to trim

their toe-nails. Sometimes rheumatism or gout may complicate these changes.

Treatment.—In early stages, the wearing of properly made boots, *i.e.*, of sufficient length and breadth, combined with rest, and relief of pressure, will suffice to effect a cure; but ordinarily a light apparatus, to be worn day and night, is necessary. In later stages, it is well to try drawing the toe as nearly as possible into proper position and fixing it with strapping to the adjoining toe, placing a pad of lint or cotton-wool between them. In some cases, a special sole, with a properly shaped projection between the affected toe and its neighbour, will suffice. A V-shaped block fixed to the sole and fitted between the toes is often of service. The apparatus shown in the annexed figures are very useful in the severe forms, and they sufficiently explain themselves; others have been constructed, some of which do not allow of progression; others limit the movement of the toes in the sense of flexion and extension; but these, if properly constructed, can be worn inside a largish boot, and will usually, in time, correct the deformity in many cases. Tenotomy of the transversus pedis and first plantar interosseus will be necessary if these means fail.

In cases complicated with inflamed corns and bunions, these must be treated on ordinary surgical principles, and if the bursæ have inflamed and communicate with the joint, the question of producing anchylosis of the joint, which, if bony, would be a hindrance to walking, must be balanced against excision or amputation. In some cases, when there is no inflammation, and a fair trial of these machines has not been productive of complete benefit, tenotomy of the external lateral metatarso-phalangeal ligament, and of any tendon displacing the toe, must be adopted, previous to resorting to more radical measures, such as osteotomy, excision, or amputation. Mr. Barker has

recorded in the *Lancet* of April 12, a case of cuneiform osteotomy for hallux valgus, and states that the operation was suggested to him by Mr. C. Hoar, a student at University College.

Hallux varus or **Pigeon-toe.**—This is the opposite deformity to hallux valgus, and in it the great toe is deviated to the mid-line of the body and drawn away from its fellow.

Causes.—It may arise independently, but may complicate pes equino-varus. I have also seen it in severe genu valgum, and then it appears due to expansion of the toes, in order to get a firmer grasp of the ground during progression. It may also be due to contraction of the abductor hallucis, and it may be a premonitory symptom of a form of paralysis which leads to spastic or rigid contraction and retraction, producing first varus, and then equinus.

Symptoms.—The deformity is obvious, and the patient complains of difficulty in getting a boot on, of cramps on the inner side of the foot, and of pain after walking or standing.

Treatment.—A sandal with an arrangement to keep the toe in place should first be tried. Disease of the nervous system, if present must, of course, be treated. Electricity, massage and manipulations, if indicated should have a fair trial, and, finally, tenotomy of the abductor hallucis may be needed.

VERTICAL DISPLACEMENT OF THE TOES.

Varieties.—These may be of three kinds; (1) the whole digit may be flexed; (2) or it may be extended; or (3) the first phalanx may be in extension, and the others in flexion.

Causes.—These are *mechanical*, *muscular*, and *nervous*. The *former* are due to short boots cramping the toes in

a flexed condition; the *second* may be due to primary or secondary contraction and retraction of muscles, and the *last* are seen in paralytic cases, and especially in the great toe, the first phalanx of which is extended and the second flexed. A rare cause is contraction of the digital prolongations of the plantar fascia. This malady may be also *congenital* or *hereditary*, when it oftenest occurs in the second or little toes. It may also result from prolonged disuse of the lower limb, especially when a paralyzed patient lies for a long time on the back and the weight of the clothes is borne on the toes; the flexors may then become retracted. A *predisposing cause* exists in those whose second toes are longer than the first.

Symptoms.—Difficulty and pain on walking, usually referred to the prominent joint, and to the balls of the toes, which are the points of greatest pressure and friction, and corns and callosities may form, and complicate the affection. On examination, the extensor tendon will be found stretched over the metatarso-phalangeal joint, and on attempting to straighten the toes, the flexors will commonly be tightly stretched.

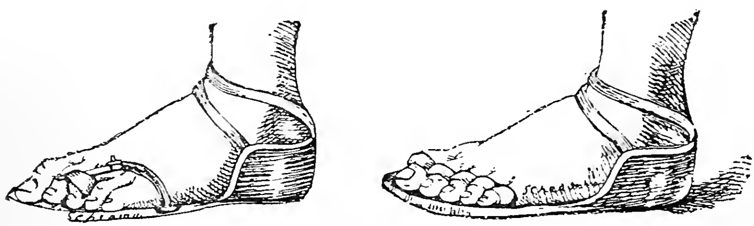
FLEXION OF THE TOES.

This may be *partial* or *complete;* in the former the second or third phalanx is affected, or both together. It is extremely rare for the proximal phalanx to be flexed on the metatarsal, except in old paralytic cases of equinus.

Treatment.—This must depend upon the cause. If due to badly fitting boots such must be corrected, and a sole or sandal, with slits between the toes, and straps, buckles, or strapping, fastened over them to fix them down, must be worn, and this can be easily done if the boot be made to lace up the middle as far as the metatarso-

phalangeal joint. When the muscles are shortened, tenotomy of the contracted tendons will be necessary, followed by subsequent gradual stretching, and in paralytic cases, manipulations, galvanism and retentive apparatus, should be tried, before tenotomy is resorted to. The accompanying figures of apparatus, which I have found serviceable, may be worn for some time before operation is attempted, and especially at night. The illustrations sufficiently explain themselves.

When tenotomy of the flexors is necessary, both of them should be divided subcutaneously at the same time, and if gradual extension do not remove the deformity, and if pain



FIGS. 149 and 150.—Sandal with spring and one with loops for hammer-toes.

and inconvenience remain, the question of exsecting a portion of the tendon, or even of amputation of the affected toes, will have to be considered.

EXTENSION OF THE TOES.

Extension of the Entire Toe.—This may affect one or several toes, but especially the first, which is at the same time displaced outwards.

The *causes* and *symptoms* are similar to those producing flexion.

Treatment.—This is similar to the preceding, in early stages, but in old or severe cases, tenotomy, or even excision

of the portion of the affected extensor tendon may become necessary. In performing the latter operation, the tendon is cut down upon, the skin flaps retracted, and the part of it nearest the muscle should first be divided; for if the distal portion be first cut, it may retract, and the difficulty of finding it will complicate the operation. In the worst cases, especially if bad corns or bunions have formed, amputation may become necessary.

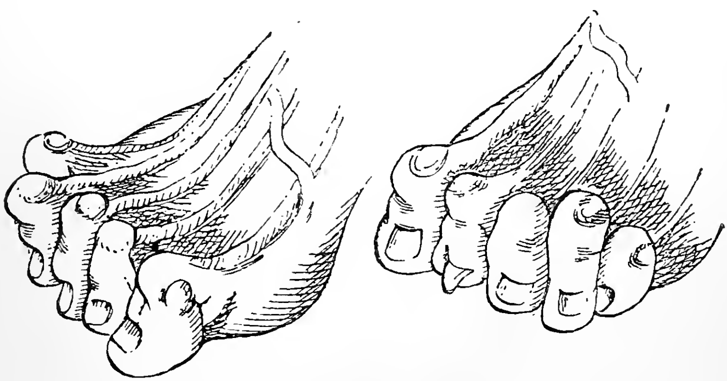
EXTENSION OF THE FIRST PHALANX AND FLEXION OF THE OTHERS.

Hammer-Toes.—In this deformity, the first phalanx is drawn towards the dorsum of the foot and it forms an angle, open superiorly, with the corresponding metatarsal, while the two remaining phalanges are strongly flexed. This condition is known as *hammer-toe.* If the great toe be thus affected, the ungual phalanx is alone flexed. In some cases, the heel is somewhat drawn up and the foot broadened, and during walking, which is done with difficulty, the toes spread and their balls appear to grasp the ground as in the case illustrated, which was taken from a woman aged thirty-three, and was neurotic, and probably congenital in origin, as she said she had always had it, and her mother confirmed the statement. I was inclined to think it might be due to some infantile nervous affection. The more prominent toes had corns over the interphalangeal joints.

Symptoms.—The projecting angle formed at the joint between the second and distal phalanges becomes subject to the friction and pressure of the boot, and a corn forms, under which a serous bursa may develop, and this is separated from the joint only by the extensor tendon. Should this corn and bursa inflame, an abscess may form in the bursa, and this may burst and leave a fistulous open-

ing externally, or it may communicate with the joint and lead to its destruction. In advanced cases, there is pronounced swelling and redness about the articulation, while the proximal phalanx appears considerably diminished in size. The pressure of the ball of the last phalanx on the sole of the boot may produce abrasions of them and severe pain, and may also lead to inflammation about the nail. Corns may also form over the bulb of the toes, and if they inflame, may seriously complicate matters.

Pathology.—Boyer considered that this deformity was



FIGS. 151 and 152.—Both feet of a patient (see text) the subject of congenital hammer-toes.

due to the simultaneous retraction of the extensors and flexors. Mr. Nunn* thinks that some of the plantar muscles are involved. I have seen a few cases which were due to contraction of the plantar fascia alone and were cured by its division. In most cases the deformity is secondary to mechanical causes, as already described, and in others it is an indication of nervous disease acting through the muscles.

Treatment.—In early stages this is similar to that given for the other deformities in flexion and extension, but, if

* "Trans. Clin. Soc." vol. xi. p. 153.

these do not suffice, tenotomy, or excision of a portion of the extensor tendon, may be necessary. Goyrand has divided the flexors and was able to partly correct the deformity, but there remained an angular tendency at the joint between the distal and second phalanges. I have most often divided the extensors, and with appropriate subsequent treatment have succeeded in correcting the deformity, but in some severe cases I have also had occasion to

FIG. 153.—An infant with congenital occipital encephalocele, whose hands and feet were much deformed, and are represented in the next illustration but one, and in the chapter on the fingers.

divide the flexors when the deformity has been entirely overcome. I should, in all cases, first try tenotomy of the extensor, and this failing I should resort to excision of a portion of the affected extensor tendon, or to tenotomy of the flexors, with gradual subsequent correction of the deformity. In the above-mentioned case, three weeks after tenotomy of the extensors and the use of splints, I *forcibly stretched* the flexors, which yielded with an audible noise.

The foot was put up in Paris plaister, the toes being fixed in the corrected position. Passive motion of the toes was adopted in three weeks after the operation, and subsequently both Achillis tendons were divided. The result was very satisfactory. In the severest cases, where there is inflammation and joint or bone disease, amputation is the best resource.

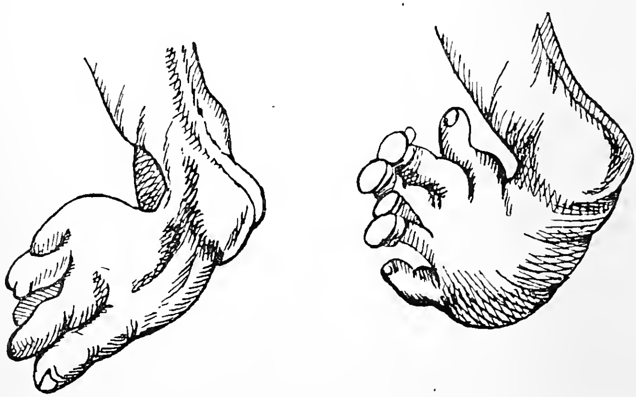
Syndactylism and Polydactylism.—The causes of these are similar to those described in the chapter on the hand. Acquired union of the toes is the result of burns. Webbing of the toes does not usually call for operation, and if operation be necessary, similar plans to those recommended in the section just named, may be adopted with success. *Supernumerary* toes, if in the way, must be removed, and I have had occasion to remove several, generally an extra big toe attached at, or near, the inner side of the metatarso-phalangeal joint. There is no fear even if there be a common joint cavity opened. Two conjoined toes fused into one joint, usually produce no symptoms calling for operation.

FIG. 154.—Defective first and fourth toes, and webbing of second and third, of right foot in a boy. The left hand was deformed and is represented in the next section.

Deficient or Excessive Development. — These, though fairly common in orthopædic practice, need not occupy our space, except to say that the cardinal rule is to interfere as little as possible with the foot, unless absolutely necessary. Overgrowth of one or more toes, if forming a great deformity, or causing serious inconvenience, may be treated by amputation.

Bunions, Corns, and Ganglions.—Though these are deformities, and also serious inconveniences to progression, and frequently come under the care of the orthopædic surgeon, I need not occupy time and space by entering into their pathology and treatment, which, for practical purposes, are sufficiently described in the various surgical text-books.

In-turned Toes.—This is a condition in which one or both feet are directed inwards in walking, and in some



FIGS. 155 and 156.—Right equino-valgus and deformed toes, and left equino-varus and supernumerary clubbed and deformed toes from the encephalocele case.

cases there is not complete plantar contact in progression, as the inner part of the sole is raised and the weight borne on the outer two-thirds of the sole. The affection to which I now allude has nothing to do with the early walk of a cured, or of a slight varus, though it may be, in some instances, a premonitory sign of an incipient acquired varus of nervous origin. Subjects of this affection are termed *duck-footed.*

Causes.—In many cases it appears to be due to persistence in a bad habit of walking, in others, it is due to corns, or follows on a bad sprain, and in others, it is depen-

dent on an incipient, or is the result of a confirmed, paralysis.

Treatment.—The nervous cases must be dealt with according to the stage of the disease, and the state of the parts. Those due to injury, or corns, usually disappear on the cure of the malady producing them, and are but temporary symptoms. Those due to habit, are best dealt with by making the patient wear an apparatus, which consists of a pelvic band with outside irons. The band is in two segments, and thus permits, by means of straps attached thereto, of everting the feet.

PART IV.

DEFORMITIES OF THE UPPER LIMB.

CHAPTER XX.

CLUB-HAND.

Definition.—Club-hand is a more or less permanent deviation of the hand at the wrist, in flexion, extension, abduction, or adduction, or in one of the intermediate positions.

Synonyms.—German, *Klumphand;* French, *Main bote.*

Varieties.—The term club-hand has only been applied to these deformities during the present century, and they were first named after the corresponding deviations in the feet, and divided into varus, equinus, &c.; but a more rational nomenclature succeeded this, and consists in naming the distortion according to the physiological position of the displaced hand. Thus, if it be in flexion, it is termed *palmar* club-hand; if in extension, *dorsal;* if in abduction, *ulnar* or *cubital;* if in adduction, *radial;* and when the hand is in intermediate positions it is termed *radio-palmar*, *cubito-palmar*, *dorso-radial*, *dorso-cubital*, &c. This deformity may be *congenital* or *acquired*, and may be *single* or *double.*

CONGENITAL CLUB-HAND.

As a deformity occurring by itself it is rare, very much rarer than club-foot, but at the Royal Orthopædic Hospital about three cases of the deformity—generally associated with some other malformation—are presented annually. It need only be mentioned that this distortion is not infrequently met with in monsters, but these need not detain us.

Causes.—Similar ætiological reasons to those adopted in congenital club-foot, and other limb deviations, are applied here, viz., malposition and pressure in utero, and the ligamentous, muscular, nervous and osseous theories are brought to bear; but in this deformity, there is frequently, paralysis of some of the muscles, as well as deficiency of some of them in whole or part, and also changes or absence of some of the osseous structures, whereas in ordinary club-foot paralysis is not usually present, and absence of bony structures is very rare. So far as these cases have been submitted to examination, it appears, that though paralysis, and in other cases, shortening of some muscles is present, yet this does not entirely confirm the nervous origin of the deformity, because these changes may be secondary. The osseous theory, which imputes club-hand to a deficient development, or original imperfection of the bones, appears more probable, from the fact that, in many cases, there is atrophy or absence of some of the bones, especially of the radius, outer part of the carpus, first metacarpal, and thumb.

Pathological Anatomy.—There are *three chief groups*, or varieties of this deformity, viz., 1. In which some of the bones of the forearm, wrist, and hand, are incomplete and malformed, and this is the commonest form; 2. In which

the bones are complete, but malformed ; and 3. In which the bones are present and well-formed. In the first variety there is more or less absence of the radius, and the thumb is often absent. The ulna may be large and strong, forming a projection at the inner side of the wrist, or it may be short, thick, and curved back and inwards. The change most commonly met with is more or less absence of the

FIG. 157.—Double congenital club hands and feet occurring in the same infant.

radius, with or without bony deficiency, or deformity, of the carpus, metacarpus, and phalanges.

Malgaigne (Leçons d'Orthopædie) describes three preparations in the Musée Dupuytren. In the slight case, the radius was present ; in the second, there was almost complete absence of the radius, but the thumb was present ; and in the third, the radius and thumb were absent. The articular surface and lower part of the shaft of the radius are most often wanting, sometimes some of the carpal, or metacarpal bones—especially the first and its corresponding

phalanges—*i.e.*, the thumb, are absent. There is commonly some distortion of the wrist-joint, and the ulna joins, or articulates with it.

The *muscles* in the first variety are absent in part, but in others they may be normal as to number, but they are bound down in a peculiar and constricted way by a strong deep fascia, and some of their tendons are deficient, or unusually arranged. In the other forms, especially in the simplest, the *tendons* are found contracted on the deformed

FIG. 158.—Radio-palmar club-hand, thumb absent.

border of the limb. *Ligamentous* changes, in the severe forms, correspond to the *articular*, in position and extent.

The *vessels* and *nerves* are often altered. The radial artery is frequently absent, and on attempting to extend the hand it becomes blanched. The ulnar artery is enlarged, so that while the superficial palmar arch is fairly complete, the deep one may be more or less deficient. The median and ulnar nerves are often coalesced, forming a single trunk down the front of the forearm. These structures will be displaced in accordance with the deformity.

Classification, Nomenclature, and Symptoms.—Though these deformities have been compared to the

different kinds of club-foot, they do not in reality resemble them, but rather those rare deficiencies and distortions of the lower limb, several of which I have seen, and two of them are represented in the chapter on deformities of the foot. The *simple* or *pure* forms—radial, ulnar, &c.,—are very uncommon, but the *composite* or *compound* forms are more frequently met with in a large orthopædic experience. In this respect it resembles club-foot.

The *radio-palmar* is the commonest form, the *cubito-palmar*—which is its opposite—is much rarer. In the former, the thumb is often absent, and the hand forms an

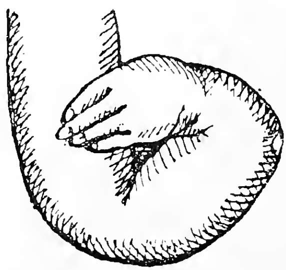


FIG. 159—Left radio-palmar club-hand. The lower part of radius and thumb were absent.

angle, open externally or antero-externally, with the radial border of the forearm, and sometimes the outer border of the hand touches that of the forearm, or even of the arm. The lower end of the ulna projects at the lower and inner side of the forearm, and its styloid process is readily felt.

The *cubito-palmar* presents the opposite deformity, and the above description reversed will fairly well represent its appearance.

The *palmar* is one of the commonest of the *simple* forms, and in it the hand is flexed, and the fingers and palm turned towards the anterior or flexor surface of the forearm. The projection at the wrist on the dorsal surface

is formed either by the lower ends of the radius and ulna, or by the carpal bones. This variety is oftenest combined with a radial, and then with an ulnar deviation.

The *dorsal* form, whether pure or complex, is very rare, and the reverse of the palmar description will suffice for its portrayal.

The following *summary* will make these deformities more readily understood.

The *simple* forms, such as the radial, ulnar, palmar, and dorsal, are rare. Of these, the radial and palmar are the

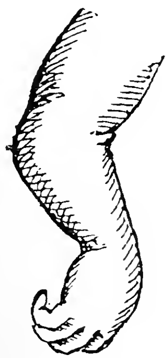


FIG. 160.—Cubito-palmar club-hand. Not a severe case.

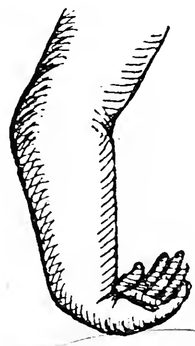


FIG. 161.—Dorsal club-hand.

commonest, then the ulnar, and last the dorsal. In the *radial* the hand is abducted and its radial border turned towards the external border of the forearm. In the *cubital* the hand is adducted and its inner border is towards the ulnar side of the forearm. In the *dorsal* the hand is extended and bent towards the extensor aspect of the forearm. In the *palmar* the hand is flexed and turned to the flexor aspect of the forearm.

The *compound* forms are commoner, and of these the radio-palmar occurs most frequently, then the cubito-palmar.

The dorsal forms, whether radial or ulnar, are the rarest. In the *pure dorsal* the hand is extended and bent towards the posterior or extensor surface of the forearm, and in severe cases may touch it. This and its composite forms are very rare. Though any of these forms may occur of themselves, they are most commonly associated with deformities in other parts of the trunk, or in the lower limbs.

In the course of a large orthopædic and general experience I have seen instances of most of these forms and had drawings taken of them; and some of these, in a reduced form, illustrate the text.

Treatment.—This will vary according to the nature of the case, and consists, in those cases that admit of it, in tenotomy of any tense tendons, and the use of instruments and manipulations. In simple cases, where one or more tendons have clearly been tense, I have succeeded in correcting the deformity by tenotomy, and the subsequent application of a properly constructed instrument, and the use of ordinary orthopædic means, such as those adopted in the after treatment of club-foot, viz., frictions, massage, &c. In two severe cases much benefit was derived from properly adjusted machines, combined with massage, &c. Mr. Schramm made a very efficient and light apparatus suitable for these cases. In the worst forms nothing can be done except amputation, but as there is frequently much use in the deformed limb, this measure should be avoided, in most cases.

Tenotomy.—Division of the tendons of muscles moving the *hand* is a thoroughly satisfactory operation as far as their reunion is concerned, but opinions differ as regards the safety of dividing the tendons of the flexors or extensors of the *fingers*, as in some the operation has been followed by non-union and consequent loss of mobility;

but if the place of operation be properly selected, and the after-treatment be properly conducted, there is no fear—in cases suitable for the operation—of non-union or the production of the opposite deformity. After tenotomy, the deformed parts must be replaced in their original position for three to five days, and then carefully and gradually extended, and when extension is complete, massage and the use of a properly constructed instrument for a few months, will suffice to cure the deformity.

In *radial* club-hand the extensors of the wrist on the radial side, one or both, may require division, and in severer forms the long and short extensors of the thumb may have to be divided.

In the *ulnar* form, the extensor carpi ulnaris may need division.

In the *palmar* deformity, the palmaris longus and flexors carpi radialis and ulnaris may need section. In dividing the two latter muscles care must be taken to avoid wounding the radial artery, which is to the outer side of the tendon of the flexor carpi radialis, but, in congenital cases, this is usually absent; and the ulnar artery and nerve, which is also on the outer side, and somewhat beneath the tendon of the flexor carpi radialis must not be divided. The median nerve lies deeply, between the two portions of the flexor sublimis and is not in danger, and the radial nerve has become cutaneous, so if it were injured, only temporary anæsthesia would probably result. In the worst cases, it may be necessary to divide the tendons of the superficial and deep flexors. This must be done on the fingers, as described in the chapter on contracted fingers.

In *dorsal* club-hand, if the two radial extensors and the ulnar extensor, be tense and resist reposition, they will need tenotomy, and if this do not suffice, the extensor communis must be divided.

In *mixed* cases, those tendons which are tense on attempting to reduce the deformity, must be divided, and will vary with the nature of the case.

It must be recollected, that in ordinary congenital club-hand the tendons are not, as a rule, primarily contracted, but may become so secondarily. In the acquired forms, presently to be described, they often need division, being in a retracted state.

ACQUIRED CLUB-HAND.

This distortion is rarely so well marked as in typical cases of congenital club-hand, but some of those due to nerve changes which I have seen, have been of a severe character. Duchenne and other neurologists figure some bad forms of club-hand, and all physicians attached to hospitals for the treatment of nerve diseases, must have seen several well-marked cases.

Causes.—Injuries such as severe sprains, fractures near the wrist, or dislocations, may lead to permanent displacement and retraction of the tendinous and ligamentous structures around the joints, or primary or secondary inflammations, with retraction and adhesions of the tendons to their sheaths, may produce varying degrees of deformity more or less simulating club-hand, as may also contracted cicatrices from severe burns, or disease of the carpal joints. Central nervous lesions producing irritation and contraction, or loss of function and paralysis, are commoner causes.

Symptoms and Diagnosis.—The history of the case will ordinarily suffice to make these matters clear. In cases due to nerve lesions, there will be no paralysis in the irritative stage, but contraction and subsequent retraction of the affected muscles; and in paralytic cases, the wasted condition of the limb, the red or purple colour of the skin,

and the coldness of the limb, with evident loss of voluntary motion, will make the diagnosis clear.

Prognosis.—In most cases that I have seen, this is favourable. That is to say, with the exclusion of the nervous cases, and especially the paralytic, a very useful member may be promised the patient; and even the paralytic cases, if treated before there is much wasting of muscular tissue, and while there is yet time to do something to check the increase of the nerve mischief, may be a good deal benefited. Some cases due to inflammatory mischief along the sheaths of the tendons, require much patient perseverance on the part of patient and surgeon.

Treatment.—This must vary according to the nature of the case. If cicatricial or anchylotic, the treatment must be conducted according to the directions given in the chapters on those subjects. If *contraction* of muscles be present, these may be gradually stretched by splints, or instruments, or forcibly straightened under anæsthesia, and subsequent frictions, &c., adopted. Descending continuous electrical currents may be of use. If *retraction* of muscles be existing, their tendons must be divided. *Paralytic* cases must receive a suitable internal as well as local treatment, the latter consisting of massage, galvanism, electricity, &c.; but if these fail, and much and troublesome deformity exist, tenotomy, with very gradual restoration of the deformed parts, must be resorted to. Subsequent frictions and manipulations will be necessary for several months or longer, and a suitable light instrument, with elastic traction in the requisite direction, must be worn during the whole time. I have treated not a few cases which were cured as regards the deformity, and some of them had serviceable hands when last seen, so that I am sure it is a great mistake to tell all these patients that they are incurable.

CHAPTER XXI.

DEFORMITIES OF THE FINGERS.

These commonly occur in the direction of flexion, though the fingers may deviate from each other laterally, or be hyperextended, or displaced backwards. Various degrees of these deformities are met with in a large orthopædic experience, and fortunately the large majority are amenable to appropriate surgical treatment. I will first treat of flexed fingers, and then of the abnormalities known as polydactylism, syndactylism, &c.

Varieties.—They may be arranged ætiologically into *muscular*, *aponeurotic*, *osseous*, *cicatricial*, *articular*, *tubercular*, and *nervous*. They may also be *congenital* or *acquired*, and *traumatic* or *pathological*. The nervous, cicatricial, tubercular, and aponeurotic are commonest, if we except rheumatism and gout, which do not usually lead to exactly similar deformities, and may be classed among the articular.

Causes.—These have been stated, generally, in the previous paragraph, but a little more detail is desirable, as furnishing valuable indications for treatment. A primary myositis, leading to degeneration of the affected muscles, is rare; the osseous and articular may be due to injuries, such as fractures and dislocations, or to ostitis, or joint disease. Severe burns are the most common of the cicatricial cases; the tubercular forms are due to *dactylitis*

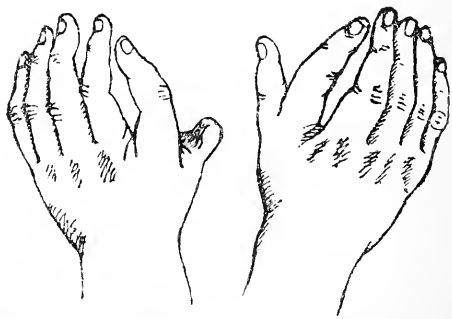
deformans, and specially occur in strumous children; and the rheumatic and gouty forms are too well known to need description here. The congenital cases may be caused by defective development and improper conformation of the digital structures, or may be due to nerve irritation, or contraction of the palmar fascia. I have seen a case in a baby which was attributed by the mother to teething convulsions. Of all these forms the nervous, cicatricial, and aponeurotic are most frequently met with in hospital orthopædic practice, and will be chiefly dealt with. The nervous cases may be seen when there is nerve irritation, and then there will be contraction of the affected muscles, and subsequent retraction. There are also the numerous paralytic cases.

The *congenital* cases consist in webbing, or union of the fingers; in excessive development, *i.e.*, supernumerary digits; defective development, *i.e.*, absence of them, and part of the hand; hypertrophy and contractions, *i.e.*, flexed fingers. The *acquired* forms are most commonly due to nerve lesions, or to injury of the muscles, tendons and their sheaths. There is also the affection of the palmar fascia, known as Dupuytren's contraction. A peculiar condition, which in this work is for the first time described in this country, I have termed *jerk* or *spring* finger. As most of these conditions are amenable to surgical treatment, I shall deal with them separately, first considering the congenital forms.

CONGENITAL DEFORMITIES.

Supernumerary Fingers, *i.e.*, **Polydactylism**, is in orthopædic experience, a not very uncommon occurrence. It occurs in *three chief forms*. 1. The supplemental digit is rudimentary, and is usually attached by a pedicle to one of the fingers, generally on the outer or inner side of the hand, or to the distal ends of the metacarpal bones. It

may contain a little cartilage. 2. The extra digit, fully formed, may articulate with the joint ends of one of the fingers, or with one of their lateral surfaces, or with a metacarpal bone. 3. There may be a united double-finger, *i.e.*, the extra complete digit may be joined to the whole length of its neighbour, and may possess, or not, a separate metatarsal bone. If this be absent it articulates conjointly with its neighbour. In such a case, there is commonly but one capsular ligament, and the joint cavity belongs to both fingers.



FIGS. 162 and 163.—Supernumerary thumb (to left); extra index (to right.)

Treatment.—Those of the *first order* should be removed, as also those of the *second*, if they are useless incumbrances; but in the *third variety*, if the deformity be unsightly as well as useless, amputation is the best resource. In the case of the extra finger having a common articular cavity with its neighbour, it has been recommended not to remove it, because of opening the joint, or to remove it at some distance from this; but the plan appears to me bad, for if the finger be removed at all it must be removed entire, and to leave a projecting stump is often more unsightly and inconvenient than to remove the whole digit. More-

over, in many instances, I have removed the extra finger or toe at the joint, and never have seen any bad results.

Syndactylism consists in the lateral union of fingers by means of soft parts, or it may be of the third variety spoken of in the previous paragraph. There are three forms. 1. The membranous. 2. The fleshy. 3. The osseous, or rather, cartilaginous. The first is the commonest. If folds of skin be the uniting medium, they are then known under the name of webbed fingers. The inner fingers are, in

FIG. 164.—Bifurcated or double hand ; no thumb.

my experience, more commonly united, but any of them may be joined, though it is rare to find a thumb united to the index. The web may be *partial* or *complete*, in the former, it only extends along the first interphalangeal joint, or perhaps a little beyond ; in the latter, the fingers are united to near their tips. The web may be short, *i.e.*, the fingers are closely united, or it may be loose, allowing of a certain amount of separation. In the latter case, the fingers are of greater use, but as the deformity is unsightly, treatment is called for.

The *acquired* cases are those of cicatricial webbing, which are not uncommonly caused by burns, especially in children, the treatment is somewhat the same. Occasionally, the web is thick and fleshy, and sometimes the union is bony. The fold of skin forming the web, has its base, which is usually concave, towards the free ends of the fingers, and its apex at the interdigital space. A slight amount of webbing, *i.e.*, an increase in the interdigital fold, is not very uncommon, and the subject appears to have short fingers.

Cause.—The study of development has explained the occurrence of this deformity. The rudiment of the hand consists in a rounded flap, with tubercles at its free end—the incipient fingers—separated by four grooves, but this separation is more apparent than real, for, in the embryo, the digits tend to group themselves two by two, and especially do the ring and little fingers affect this arrangement, hence the comparative commonness of their union. The arrest of the process which deepens the grooves and separates the fingers, is the cause of this deformity.

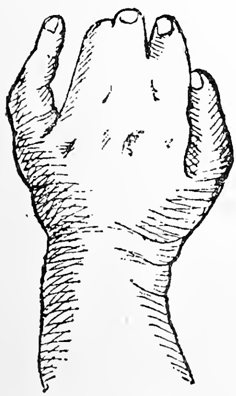


Fig. 165. — Stunted and webbed hand.

Treatment.—Formerly, it was the custom to slit the web and to prevent reunion by strips of wet or oiled lint, pushed firmly down between the heads of the metacarpal bones, but there was such a tendency either to reunion, or to cicatricial contraction, reproducing the web, that other means had to be devised. This led to the following plan :—

Operation by a Permanent Opening at the Base of the Web.—A silver or gold ring with a sharp point is passed through the base of the web, and the other end of

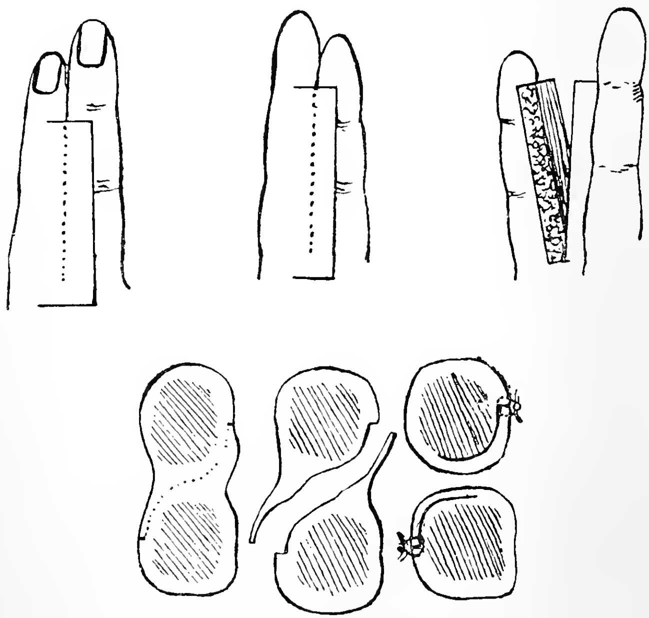
the ring being hollow, the sharp point is fitted into it, and the ring left in place. It must be shifted from time to time until cicatrization has occurred around it, then the web is slit down with a scalpel, and the fingers kept apart by oiled lint, well forced down into the base of the web, until healing has taken place.

The same object may be effected with the use of a silver rod, or bracket. This consists of a screw at one end, on to which is fixed a sharp point. This is made to transfix the web at its base; the sharp point is then detached, and a nut is then screwed on so as to retain the apparatus in position until cicatrization has occurred. The remainder of the web is then treated as already described.

The third plan is by elastic traction. An india-rubber cord is passed through the base of the web by means of a trochar and canula. This passes along the palm and dorsum, and is attached to a circlet at the wrist, and by keeping up occasional gentle traction, it will, by its tension, make a good opening at the base of the web, and when healing has occurred around it, the web may be dealt with as already described. Some surgeons, not satisfied with the results of these plans, have devised plastic operations, of which there are several; but the three which I shall describe, appear to me to be the best. I have tried them all, and can speak well of them.

Didot's operation.—The accompanying illustrations, which represent the middle and ring fingers, will sufficiently explain this method. An incision is made along the middle of the palmar surface of one finger, and is joined, at each end, by short transverse cuts, so as to form a flap. A similar proceeding is executed on the dorsum of the other finger, and two flaps are thus formed. The palmar flap of one finger fits over the dorsal surface of its neighbour. The transverse sections of the fingers are shown, and the

figure to the left shows the line of the incisions, the middle figure shows the flaps separated, and the right hand one represents the flaps in position. It is well, as Annandale has pointed out, to avoid making the flaps broad, so as not to encroach unnecessarily on the palmar and dorsal surfaces of the fingers. The inter-digital cleft must be carefully



FIGS. 166, 167, 168, and 169.—Diagram of the incision and flaps in Didot's operation. The dotted line shows the limits of the adjoining fingers.

watched to prevent recontraction, which always commences there, and is a drawback in this otherwise excellent plan.

Zeller's operation.—Two incisions, A and B, meeting at C on the dorsal aspect of the web and fingers, are made, and extend from the metacarpo-phalangeal to the first inter-phalangeal joints. This triangular flap is reflected towards its base, and the remainder of the web is divided along the line C, D. E and G represent the reflected flap

and the raw surfaces of the fingers after division of the web. The fingers being held well apart, the flap is fixed to the palmar surface and between the cleft, and obviates the tendency to contraction.

Decè's operation.—When the web is large he pinches up a fold of skin near its base and dissects it towards the commissure, and keeps the fingers apart. On cicatrising, this tongue of skin retracts and gradually forms a new commissure.

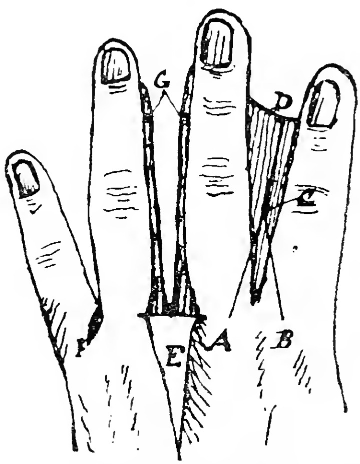


Fig. 170.—Diagram of the incisions and flaps in Zeller's operation.

Norton's operation.—In the *British Medical Journal*, August, 1881, Mr. Norton has described an operation which is a decided improvement on that of Decè's. Small rounded anterior and posterior flaps are made at the clefts, with their bases at the heads of the metacarpal bones. The web is then divided and the flaps joined at their apices. The following points should be attended to:—1. The flaps should be thick, so that their vascular supply be good; 2. They should be rather narrow to prevent bulging; 3. The tissues between the knuckles should be

cut back, or removed, to let the flaps meet well; 4. The flaps must be long enough to prevent tension; 5. Their apices are very small in children, and require a small needle, so as not to injure their vessels; 6. The position of the flaps must be carefully arranged, so that the new web may be

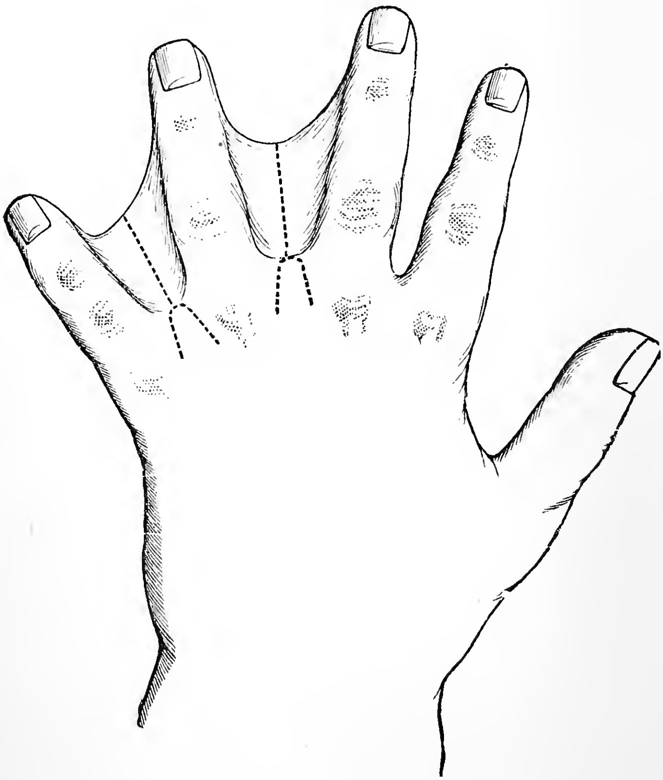


FIG. 171.—Diagrams of incisions and flaps in Norton's operation.

in a line with the natural one; 7. The fingers should be kept apart during the healing process.

Congenital Deficiencies.—These are usually of two kinds, numerical deficiencies, or those of size. In the former, one or more fingers may be absent, with or without corresponding absence of the metacarpals. In the latter,

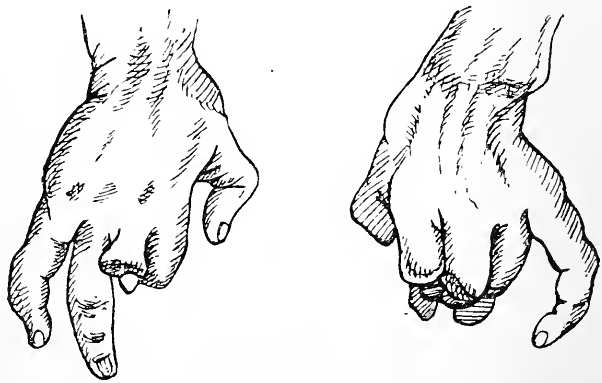
one or more of the phalanges may be wanting, or there may be the condition known under the head of congenital amputations. I have seen several varieties of these deformities, but only rarely has any treatment been likely to be of use. If there be connections between the deformed digits, then, in some cases, operative methods will be of great service. If there be contractions, these must be dealt with according to the cause of contraction. If an imperfectly developed finger be useless, or in the way, it must be removed.

Congenital Contractions are rare. They may be due to defective development in the bones, muscles, or fasciæ, or to nerve lesion, and must be dealt with accordingly. I have seen but three instances, so far as I recollect; two of these were much improved by oily frictions, manipulations, and the use of an extending apparatus. I advised the parents to bring the infants when they were a year old, but as I have only seen one of them, I concluded that they thought the others sufficiently benefited, or that they had given up further treatment, or had applied elsewhere. In the third case, in which the little finger was contracted, I divided a tense band of palmar fascia subcutaneously, and applied extension, and the finger very shortly after assumed its normal position and use.

FIG. 172.—Defective and partly webbed fingers of left hand of a boy whose right foot is represented in the last section.

Congenital Hypertrophy.—This may affect one or more digits, or may involve the hand or even the whole limb. The increase in size may be due to an excessive development of all the tissues, or of only the subcutaneous

fatty tissue. Sometimes, and this is rare, only one, or more, of the phalangeal articulations is increased in size. The cause, so far as it is known, is ascribed to excessive nutrition, or excitement of the part during development. A woman, aged forty-nine, the subject of this congenital condition, has been for some time an out-patient of mine at the London Hospital. She applied on account of rheumatic arthritis of the knees. The fingers, and especially the middle and ring-fingers, are enormously overgrown, and the



FIGS. 173 and 174.—Defective and deformed fingers from the encephalocele case figured in the last section.

former somewhat curved. A wax model of her hand is in the London Hospital Museum.

Treatment.—In infants, well regulated pressure long continued may be of service, but when this is removed the growth is somewhat apt to relapse. Some writers are for leaving these growths alone, because congenital overgrowths, and even tumours of innocent character, have sometimes been known to disappear; but in the case just alluded to, the fingers increased in size with her growth, but she declined any interference. If the finger or fingers be in the way, and they are always unsightly, amputation seems the

only radical resource; but in the event of the hand or limb being affected, ligature of the main artery may be tried.

I have seen several well-marked instances of hypertrophy, either congenital, or occurring during childhood, in the upper or lower limb; and I recollect a case which occurred at the Royal Orthopædic Hospital, under the late Mr. Daniel Hill, in which he tied the external iliac artery with certainly temporary benefit, but I do not know the ultimate result. Some of these cases are of the nature of elephantiasis, and probably lymphatic in origin.

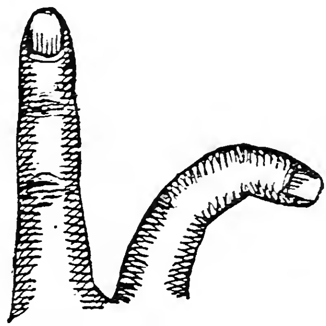


FIG. 175.—Congenital lateral deviation of left index.

Congenital Lateral Deviation.—The annexed figure shows a case of this rare deformity which occurred in a fine healthy boy, who is now under care, wearing an instrument which is acting efficiently on the displacement.

ACQUIRED DIGITAL DEFORMITIES.

Causes.—These may be the result of injuries affecting the muscles, tendinous sheaths, or nerve centres. They may also be due to contraction after burns, but there are two particular forms in which the functions of the fingers are interfered with, which deserve a somewhat lengthened notice. These are *contraction of the palmar fascia* (Dupuytren's), and an affection which I shall term *jerk*, *snap*, or *spring* finger. The deformities due to athetosis are, as far as is at present known, of a temporary character; and the clubbing of the ungual phalanges in myxœdema, and some

lung affections, need not detain us, as the treatment is not specially orthopædic.

Muscular and Nervo-Muscular Affections.—Injuries resulting in division of the muscles, or in inflammation of the tendinous sheaths, may, mechanically, give rise to either contraction in extension or flexion, according to the muscles affected. Rheumatism, gout, and syphilis, may all produce finger deformities, either through affecting the muscles or the bones and articulations. The nervous affections may be due to disease in the nerves, or in the nerve centres. In the latter there is flexion of the fingers, because

Fig. 176.—Muscular contraction of fingers.

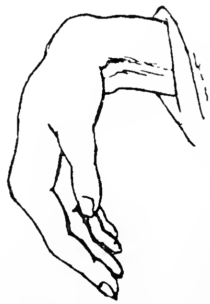


Fig. 177. — Contracted flexors from infantile paralysis.

Fig. 178.—Contracted extensors.

the flexors are more powerful than the extensors. In lead-palsy this is more marked, as the extensors are then affected. The deformity due to paralysis of the interossei is marked by the proximal phalanx being extended on the metacarpal, while the two other phalanges are flexed. In some cases of chronic spinal meningitis the fingers and the thumb are a good deal flexed, whereas in others the extensors are contracted. I have seen well marked deformities of the hand and fingers in cases of infantile paralysis, and also from hysteria. The accompanying figures illustrate some of these.

Lateral Deviation of Fingers.—The accompanying figure is taken from a young man, aged twenty, who writes a good deal, being a clerk. He comes of a rheumatic stock. His hands are large and red, and their circulation feeble, and the last phalanges of his index and middle fingers are deviated towards the thumb, and there are bony growths at the bases of the ungual phalanges on their ulnar sides. He is improving under the use of an apparatus which keeps the joints in their proper position; and I had intended in this, as in the case of the little boy with congenital lateral devia-

Fig. 179.—Wasted and deformed hand due to chronic spinal meningitis.

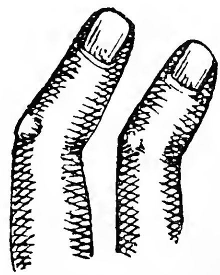


Fig 180.—Laterally displaced left index and middle ungual phalanges. See text.

tion, to divide the ligaments should the instruments not suffice for their correction.

Diagnosis.—The history of the case will generally suffice to distinguish whether the disease be of muscular or nervous origin, and the condition of the palm will serve to differentiate them from Dupuytren's contraction. If flexion predominate, we must endeavour to ascertain whether it be due to the superficial or deep flexor. In the former case, the distal phalanx can be extended, though flexed on the second. If both flexors be affected, their tendons will be felt to be stretched, on the finger being put in extension. Anæsthesia will decide as to whether the flexion be due to

contraction or retraction. In the muscular cases, flexion will be combined with adduction in the index, ring, and little fingers. I have lately divided the tendon of the flexor sublimis, and of the first palmar interosseous, in a contraction following an inflamed finger. The patient was a middle-aged woman, and her left index was firmly flexed, and the end of the digit was across the middle of the palm. There was intertrigo of the digital cleft. I divided the flexor tendon just distally to the palmo-digital fold.

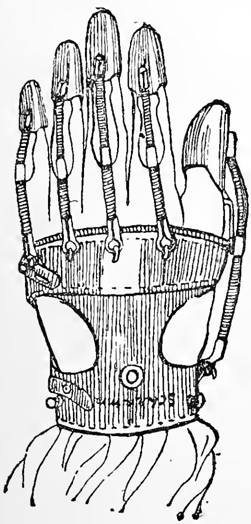


FIG. 181.—Apparatus for elastic correction of contracted fingers.

Treatment.—This must depend upon the cause, and the stage of the malady. In the traumatic cases, if it be due to binding down of the muscles or the tendons in their sheaths, I have known an incision exposing these, and freeing them of all adhesions, followed by passive motion, to be of great service. If nerves have been divided they may be cut down upon, their ends pared and brought together by stitches in the neurilemma, or by tying the nerves together as the sheath is apt to give way. I have operated on a few cases, and have seen others submitted to a like procedure with very gratifying results as regards motion, sensation, and cure of the deformity. In cases due to central nerve mischief, all irritation and spasm must have passed away before surgical proceedings can be adopted. In such cases, *stretching* of the affected nerves may be of service, but if not, tenotomy of the affected muscles, and careful after treatment, will correct the deformity. *Electricity*, *massage*, &c., should first be tried in these cases. The extensors

may be divided at the wrist, care being taken, on the outer side, of the radial artery; or they may be divided on the phalanges. The flexors are best divided as follows :—

Tenotomy of the Digital Flexors.—When these muscles are retracted, they may either be forcibly straightened during anæsthesia, or, if too resisting for this purpose, their tendons had better be cut, and this whether the retraction be due to nerve, rheumatic, gouty, or syphilitic mischief.

To divide the Superficial Flexor:—If this be retracted independently of the deep, the tenotome should be

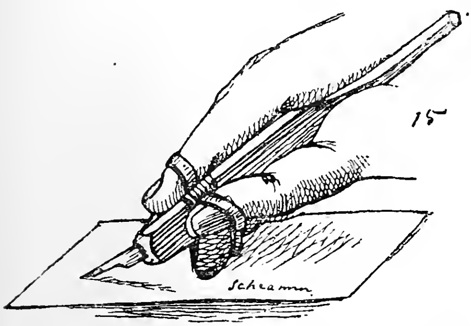


FIG. 182.—Mechanical pen for writer's paralysis.

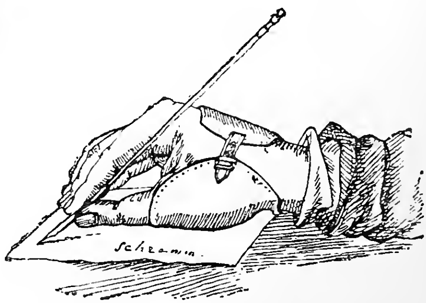


FIG. 183.—Gauntlet for the same.

introduced about a quarter of an inch in front of the base of the second phalanx, on its palmar aspect. The *deep flexor* should be divided opposite the base of the ungual phalanx, on its palmar aspect. At these spots there are processes which will prevent the divided tendons separating too far. A figure of these will be found in my Human Morphology. The subsequent treatment is the same as in other cases of tenotomy.

Writer's or Scrivener's Palsy.—This malady consists in an irregular spasmodic action of some of the hand muscles, and is shown on attempting to write, sew, or play

the piano, or in any complicated manual exercise. It is due to overwork of certain groups of muscles, and is met with in clerks, telegraphists, machinists, etc. Its pathology needs clearing up, but its symptoms, in many cases, resemble those of other spasmodic affections, *i.e.*, spasmodic wry-neck, etc.

Treatment.—Medical means are not much to be relied on, but the general health must be improved, as the disease occurs in those who, by their occupations, are much confined. I have met with the greatest success through the use of alternate hot and cold douches to the spine and affected limb, followed by free rubbing, and massage, and electricity in suitable cases. Absolute rest is to be enforced as regards *voluntary* exercise of the part, until the case is improving, when active motion must be encouraged. The apparatus, shown in figures 182 and 183, when clerks and writers are compelled to go on with their work, are of service. Neglected and severe cases may end in atrophic paralysis.

CHAPTER XXII.

CONTRACTION OF THE PALMAR FASCIA.

Definition.—This deformity consists in flexion of one or more fingers, which is due to a change in the palmar fascia and its digital expansions, and also to some secondary or primary affection of the fibrous structures of the skin.

Causes.—Injuries to the palm of the hand, repeated pressure, or frictions, the rheumatic, syphilitic, or gouty diathesis, and nerve changes may cause it. Chronic inflammatory changes, some occupations, heredity, etc., have been known to produce it. In one case of mine, in an old man, there was fibroid induration and contraction of the fore-skin, of a very similar character to that in the palm, and I regarded the pathological changes as probably identical. Richet and Ricord have each recorded cases due to syphilis, some of which yielded to iodide of potassium. Tamplin relates a case which he considered due to alcoholism, and which disappeared when beer and spirits were forbidden, but reappeared on the man resuming intemperate habits, and finally disappeared when he became a total abstainer. We know that contraction of the prepuce is met with during old age, and it is not improbable that it may be a sort of local cirrhosis here, as in the palm. In some cases of this affection no known cause can be adduced. It is more common in males than females. I was the first to point

out* that it does occur in females, and Mr. Southam, junior, of Manchester, shortly after mentioned other cases occurring in women. As regards *age*, it is commonest in, or past, middle life, though I have seen it occur in quite young subjects, and there is now a student at the London Hospital who has indurations, nodules, and puckering in the palm, over the seat of both ring fingers, which he says came on after the use of a hatchet for about an hour only on one day. He is under the impression that gout is in the family, but he has had no evidence of it in his own person. Some observers say that it may also be *congenital*, and in the chapter on Congenital Finger Contraction I have mentioned a case of mine.

Symptoms.—The patient usually makes no complaint of pain, though in some instances this is remarked. His attention is first drawn to the part by a feeling of tightness, and inability to completely extend the finger. Subsequently, the finger begins to contract, and the proximal phalanx is flexed upon the metacarpal, and the second upon it, the third phalanx remaining free as a rule, though figures 16 and 19 of Mr. Adams's book,† represent it as flexed. At a later stage there exist, usually, subcutaneous longitudinal bands from the palm of the hand along the digital prolongations of the palmar fascia. These sometimes run in a line with the fingers, and sometimes between them, affecting the prolongations of adjoining fingers. They can be traced to the anterior portions of the first two phalanges, and are usually more or less concave towards the palm, though there may be nodules in their course. The skin is often thickened and adherent, having lost its mobility; it is also dry and shows radiating furrows. This portion of skin may

* *British Medical Journal*, 1881, p. 1049.

† "Observations on Contraction of the Fingers," &c., London. 1879.

at first perspire abnormally, but subsequently it becomes dry and roughish. In a later stage, the fingers are tightly bent into the palm, and cannot be at all, or very little, extended, even passively, and, if this be attempted, these bands will stand out and be felt to be quite hard and tense.

The ring and little fingers are most commonly affected; the middle and index less commonly, and the thumb least of all, though other observers, as well as myself, have seen

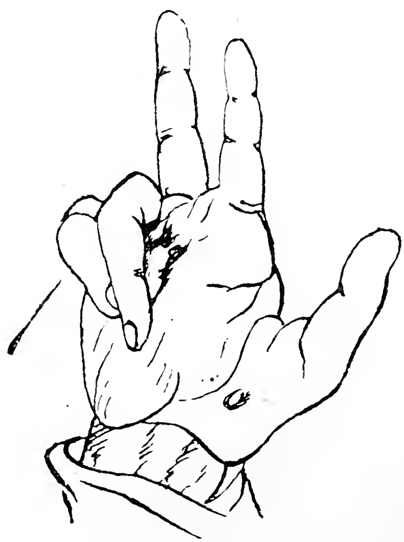


FIG 184.—Contraction of right ring and little fingers.

individual cases of the last condition. The affected fingers are generally flexed in unequal degrees, and the disease may affect one or both hands.

Pathology.—It has been clearly shown that the principal change is in the palmar fascia and its digital prolongations, and that the tendons, if affected, are only secondarily so, and in severe or late stages of the affection. These prolongations may be *longitudinal* or *transverse*, the latter are

never seen without the former. There are usually two sets; a *superficial* and *deep*, the former passing to the skin, the latter to the sides of the first and second phalanges, to the periosteum, and to the sheaths of the tendons. Dupuytren, Goyrand, Sanson, and Partridge have shown by their dissections that it is the fascia, not the tendons, which are affected. The pathological question then arises—What is the nature of the change? Some consider it a hypertrophy of pre-existing fibres; others think that there is a new formation of fibrous tissue with contractions, forming indurations; others, that these are veritable fibromata; others, that the disease is a cicatricial hyperplasia of the palmar fascia; and König regards it as a manifestation of the fibroid diathesis.

Recently, Baum of Dantzic has revived the opinion of Malgaigne, that it is due to a degenerative process of the skin extending to the subjacent fascia; but he attributes this obversation to Pitha. He says, "If in making a dissection one isolates the aponeurosis, and then if one pinches up a fold sufficient to reduce the length of the aponeurosis a half, only a slight flexion of the fingers at the metacarpo-phalangeal joint is produced, and this can be easily overcome." One cannot, if the fingers be extended, repeat this experiment on the skin, because this is so economised in the palm that it is impossible, but if the hand be flexed, (this can be done on one's own hand), and if only a small portion of the transverse fold formed, be grasped with the finger and thumb of the opposite hand, the extension of the corresponding finger is almost, or quite, impossible. If, on the cadaver, this fold be excised, it will be seen that it is formed entirely by the skin and a little subcutaneous cellular tissue. It is this economical disposition of the skin which produces the feeling of constriction which one feels in complete extension of the fingers.

He regards the fact that this tissue most commonly begins in the ring finger, as supporting his cutaneous theory. In the position of rest, the fingers are semi-flexed; and in complete flexion, as in making a fist, the other fingers meet the thenar and hypo-thenar eminences, while the ring finger is in the groove which separates them. Its extension is therefore greater, and comparatively slight alterations of the skin will affect it, while they will not be perceived by the others. Moreover, the deepest part of the palm corresponds to the ring finger and becomes more compressed in grasp-

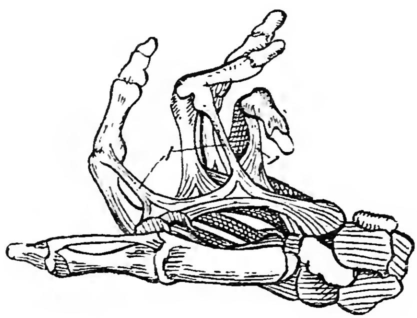


FIG. 185.—Dupuytren's contraction. Goyrand's dissection. 1. The digital processes of the palmar fascia.

ing efforts, as in ordinary occupations or pastimes requiring firm use of the hand, and thus, the skin may become slowly inflamed, and form fibrous bands. He regards Goyrand's illustration as evidence of hyperplastic changes in the skin, having a similar origin to corns, which are developed by a chronic inflammatory process due to repeated pressure and friction.

The fact that the thumb may be affected lends support to the skin theory. In the palm of the hand, that which renders anatomical diagnosis difficult, is the existence of numerous adhesions between the skin and aponeurosis, and

it depends upon the dissector as to whether the main part of the new tissue be found connected with the skin, or the aponeurosis; and, moreover, Busch's operation, which makes a skin flap and does not touch the aponeurosis, proves by its success that the change is in the skin. Baum concludes that in this malady the aponeurosis plays a considerable part, and that chronic inflammation of this is the first stage, but that soon, to relieve the pain due to this, the finger becomes semi-flexed, and if to this flexion, which at first is secondary, a permanent contraction occurs, then a cicatricial tissue is formed in the skin which causes this flexed condition. He does not furnish any pathological preparation to support his view, but relies upon the benefit afforded by Busch's operation.

Lanceraux, in 1881, had the opportunity of dissecting both hands of a man aged sixty-one, a varnisher, and the experiment of removing the skin, which was intimately adherent to the aponeurosis, showed that the movements were not at all affected, *i.e.*, that the finger could not be straightened after its removal. The skin was considerably thickened, and the contraction was due to a longitudinal band of palmar fascia which passed to the base of the second phalanx, the flexor tendons were perfectly free; the microscopic examination of the skin by Variot is very interesting. Under a low power, he found the skin considerably thickened, the papillæ were normal, but the deep layer of the skin passed without interruption into a thick layer of fibrous tissue, all of which was stained rose-colour with carmine. It was in this subcutaneous fibrous tissue that the change was found. The tendons and their sheaths were intact, and in those portions of the metacarpo-phalangeal joint which were in contact, the cartilages were normal, but they were eroded and yellowish at the posterior parts of the heads of the metacarpals. The skin, under the

higher power, showed that the superficial layers of the epidermis had undergone incomplete carnification. The cells were polyhedric, the nuclei became coloured with carmine, and somewhat resembled the epithelial covering of the mucous membrane. This imperfect transformation of the epidermis is attributed to the immobility of the part protecting it from friction. The papillæ and the true skin were very slightly altered, the latter being a little thickened.

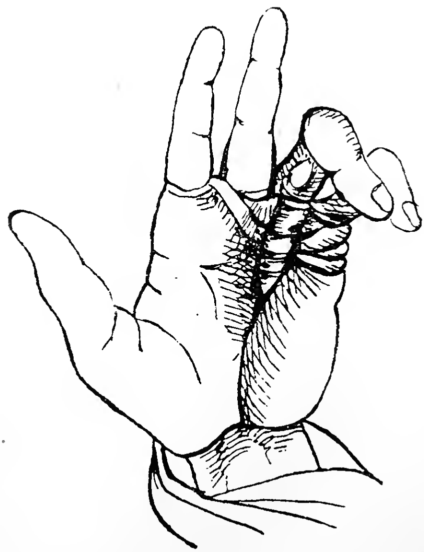


FIG. 186—Dupuytren's contraction and nodules on left ring and little fingers.

This deeper layer was devoid of fat, and was continuous with the subjacent fibrous tissue by similar tissue, somewhat less tense. At some points, the walls of the sudoriferous glands appeared thicker than normal, but their epithelium was preserved. The fibrous tissue causing the contraction consisted of a very coherent fibrillar tissue, like tendon tissue. Its fibres were extremely close, and were devoid of fibro-plastic interlocated cells, and of elastic tissue. It was, in fact, a scirrhous cicatricial tissue.

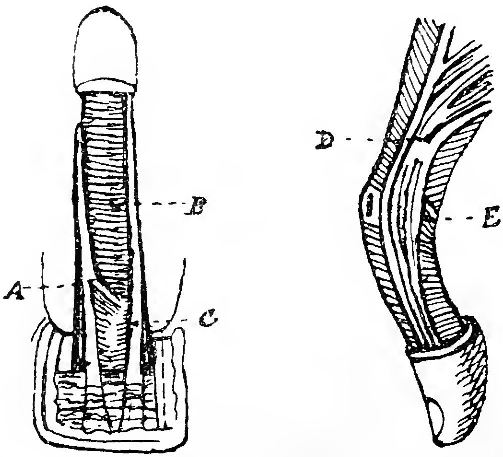
This case clearly shows, that besides the much increased thickness of the aponeurosis, certain changes of the skin and subcutaneous cellular tissue were observed. The thickening of the epidermis and of the skin, the disappearance of the fatty areolæ, and the interposition of a tense tissue uniting the skin to the aponeurosis, or rather making one layer of both, so close that they had to be artificially divided, and the thickening of the sudoriferous glands, show, that whether primarily or secondarily, the skin is consideraly affected. It will thus be seen that this cirrhosis extends to all the fibrous tissue of the affected parts; skin, cellular tissue, aponeurosis, and ligaments, are indurated, thickened and contracted.

O. W. Madelung* considers the contraction as secondary, and that the first pathological change consists in the disappearance of the fat pellets from between the fibres of the palmar fascia, and also between the prolongations which it sends to the skin. He says that age produces the disappearance of this fat, but traumatism and inflammation also. The fatty tissue serves to protect the deeper layers against pressure, and when it has disappeared, certain parts of the palm, more exposed than others, may be injured by frequent pressure, especially at the heads of the metacarpals. This repeated pressure produces inflammation, then hyperplasia, and retraction of the fibrous cords. When the retraction has reached a certain stage, the patient, by attempting to straighten the finger, only aggravates the lesion, and when the flexion of the fingers is such that the patient can no longer use them, the malady stops, and it is then that Busch's operation succeeds, for it removes the protuberance formed by the cellular tissue of the palm of the hand.

* "The Causes and Operative Treatment of Dupuytren's Finger Contraction." Translated and published by the late Mr. Trubner, London, 1876.

Madelung is therefore a believer in traumatism as a cause, and his theory serves simply to explain how traumatism produces retraction.

Dr. Robert Abbe* has recently advocated a nervous origin for this disease. He says that there is first, a slight injury; second, a spinal impression produced by this peripheral irritation; third, a reflex influence on the part originally hurt, producing nutritive disturbances and new



FIGS. 187 and 188.—Palmar and lateral dissection of fingers, to show the processes of the palmar fascia. A, New formed process; C, Longitudinal processes; B, Transverse processes strengthening sheath. In the lateral view B points to the longitudinal and E to the transverse.

growth, manifested by the contracting fascial bands, and occasional joint lesions resembling subacute rheumatism; fourth, through the tense contractions, a secondary series of reflex symptoms, neuralgiæ, general systemic disturbances, and a reflection of the trouble to the corresponding parts of the opposite hand. He combats the gouty origin of the contraction, and thinks that the local mischief is—reflexly—responsible for many of the symptoms which have

* *New York Medical Journal*, April 19 and 26, 1884.

been attributed to gout. Mr. W. Adams read a paper on this subject at the Copenhagen meeting of the International Medical Congress, adhering to the gouty origin of the contraction. Mr. N. Smith also lately made a communication to the Medico-Chirurgical Society concerning it.

Diagnosis.—This is generally very easy, as the affection of the two or three last fingers, and especially of the ring finger, the slow progress of the disease, the presence of the palmar bands, and often of nodules, the thickening and adherence of the skin, the flexion of the first two phalanges leaving the third free, all serve to differentiate it from cicatricial contractions, and from inflammatory or nervo-muscular flexions of the digits. In cases of lesions of the nerves of the arm, whether from injury or nervous disease, the flattening of the thenar or hypothenar eminences, the affection of the interossei, the falling of the wrist, the Griffin-hand, and the absence of palmar bands, will serve to differentiate it.

There may, however, be slight difficulty in diagnosing it from retraction of the flexor sublimus, the profundus remaining intact. In such cases the first two phalanges will be flexed, but there will be no palmar bands, and on endeavouring to straighten the fingers, the movement will be transmitted to the tendons of the sublimus above the wrist, and, with care, there is no fear of confounding this result with the traction put upon the palmaris longus when the fingers are attempted to be straightened in cases of Dupuytren's contraction.

Treatment.—This is of course chiefly surgical, though in gouty, rheumatic, or syphilitic cases, appropriate medical means must be adopted. The surgical treatment consists in either gradual extension, or in operation. The former is carried out by means of light though effective machines applied on the dorsum of the hand, and the force should

be a constant one. It is only applicable to the slighter cases, the severer ones, or those of long standing, are only amenable to operation.

Two chief methods have been devised for dividing the tense bands of the palmar aponeurosis, that by *open wound*, and the *subcutaneous method*. The former comprises several methods, viz., those of Dupuytren, Goyrand, Cæsar Hawkins, Richet, Sir William Fergusson, Busch and Post.

Open division.—*Dupuytren's operation* is thus performed: the hand being firmly fixed and the finger brought towards extension, a transvere incision is made across the metacarpo-phalangeal articulation of the ring, which is commonly the affected finger. This incision first divides the skin, then the palmar aponeurosis, which yields with a crackling noise, and the finger can then be straightened; another transverse incision was obliged to be made in Dupuytren's case opposite the joint of the first and second phalanges of the little finger. He then separated the skin from the aponeurosis by another incision opposite the metacarpo-phalangeal joint. The second and third incisions had only a partial effect, but another one opposite the middle of the first phalanx of the little finger resulted in its being easily extended, and this result showed that the incision had divided the point of insertion of the aponeurotic digitation. The fingers were put up extended. The operation was followed by a good deal of swelling and suppuration, and the healing proceeded in an inverse manner, *i.e.*, that the incision first made, healed last. The patient subsequently recovered with useful fingers. Dupuytren records the other successful cases in the same volume.*

Goyrand's operation: Goyrand, of Aix, made longitudinal incisions over the facial bands or abnormal fibrous fasciculi, as he termed them, and divided the latter trans-

* "Leçons Orales," T. 1, p. 3.

versely. The skin he separated from the fibrous bands before the latter were incised. The fingers were put up in complete extension, and he says that the incisions united by first intention. He remarks, that if the pre-digital bridles send out prolongations to the first phalanges, before inserting themselves into the second, one should cut them above and below the prolongations.* The longitudinal skin incision, prevents the gaping which occurs on straightening the finger, if the skin be transversely incised.

Cæsar Hawkins's method: Mr. Hawkins operated on two men, one aged thirty the other thirty-nine.† He made one transverse incision in the palm for division of the large facial bands, and semi-circular incisions at the base of the little and ring fingers for the division of the digital prolongations of the fascia. Mr. Hawkins said of one patient aged thirty, "he has as much power over the fingers which were operated upon as any other." This surgeon had in his mind prior to this operation the question of subcutaneous division of these bands, which, however, was first suggested by Sir Astley Cooper in 1822.

Richet's plan:—In certain cases where the bands are thick and nodulated, Goyrand's proceeding is insufficient, so Richet made a longitudinal incision over them, and a short transverse one at each end, and dissected all the flaps thus formed, as far as necessary. He then cut or excised the band, the flaps were united and the finger fixed in extension. In one case he had an excellent result.

Sir William Fergusson's plan:—This is very similar to Richet's. Mr. John Gay operated in a case by this method, and Mr. W. Adams states that suppurative inflammation

* *Mémoires de l'Académie Royale de Médecine*, T. 3, and *Gazette Médicale de Paris*, 1834–5.

† *Medical Gazette*, 1835 and 1844. Also contributions to *Pathology and Surgery*, 1874.

followed, and the articulation was involved, but ultimately, however, the case did well, though the joint remained permanently stiff.

Busch's operation:—Madelung* has drawn attention to the treatment of this affection by Professor Busch, of Bonn. It consists in dissecting up a triangular flap of skin from the contracted palmar band, and then dividing all the bands of the fascia which are exposed, or can be reached. The base of the flap is in the groove which separates the flexed finger from the palm of the hand, and the apex is at the highest part of the band, which becomes prominent when the finger is put towards extension. The flap is dissected from apex to base, and it should comprise as much subcutaneous cellular tissue as possible. As one proceeds with this dissection, numerous fibres of communication between the skin and aponeurosis are cut, and the fingers can be a little extended. The flap being reflected, constant attempts at extension of the finger must be made, and all resisting fibrous bands must be divided from without inwards, with slight cuts of the knife. If one proceed thus, there is little fear of injuring a tendinous sheath; the finger slowly comes into extension, the skin flap strongly retracts, and its apex turns rather inwards. When the finger is extended a portion of the wound is uncovered. Sometimes the angles of the wound may be united, but if there is risk of suture-tension, this had better not be attempted. If several fingers be affected, two may be operated on at one time. A bandage closes the wound, the hand is kept in a sling, and no attempt at extension is made until the wound has entirely closed, and then only slight extension is employed by passing wood cylinders of various sizes into the palm. Skin-grafting, to accelerate the healing of the wound may be used, but cicatrization is

* *Berliner Klinische Wochenschrift*, Nos. 15 and 16, 1875; and an English Translation by Mr. Trubner, 1876.

usually accomplished in three or four weeks. Several successful cases are recorded, but one case, even under the use of Listerism, suppurated, and the flexor tendon of the little finger sloughed. Madelung says that this operation presents no important disadvantages. It is not painful, there is no fear of suppurative inflammation, hæmorrhage, synovitis, nor tetanus. Tendinous sheaths are easily noticed and avoided, vessels are readily seen and tied, and healing proceeds as in a simple tegumentary wound.

Post's operation: Dr. A. C. Post, of New York,* in contraction of the palmar fascia and of the sheaths of the flexor tendons, makes small incisions at various points, as he thinks that the adhesion between the aponeurosis and the skin, prevents the strictly subcutaneous section being made. The fingers are immediately extended and fixed to a splint, the dressings removed every two or three days, and passive motion used. Only one of the five cases related in this paper was true Dupuytren's contraction, the others depending on inflammations of the tendinous sheaths.

Mr. W. Adams† says that when in America in 1876 he conversed with Professor Post, who thought that the firm adhesion between the skin and fascia prevented the knife from being passed between them. He says, "I explained, however, that the close adhesion between the skin and the cord—even in very severe cases—never extends through the entire length of the cord, and that by flexing the hand at the time of operation it was possible to introduce the small fascia knife under the skin, and pass it between the skin and the cord, generally at the two extremities of the latter, where the skin was not adherent to the cord. This allows of an immediate gain by extension; and that

* "Archives of Clinical Surgery," 1876.

† "Observations on Contractions of the Fingers," London, 1879, p. 37.

portion of the cord at which close adhesions of the skin exists being thus isolated and freed from tension, undergoes a gradual process of atrophy and absorption, just as all the knotty cutaneous thickenings do after the subcutaneous division of the fascial bands."

Subcutaneous operations.—Sir Astley Cooper in 1822* first suggested this operation, and Bransby Cooper, his nephew, applied the subcutaneous method with success in a case of retraction of the plantar aponeurosis. Astley Cooper's suggestion was made long before Dupuytren's writings on palmar contraction, and before the reintroduction of subcutaneous tenotomy by Stromeyer. Sir A. Cooper's operation was not performed strictly according to our present notions of subcutaneous methods; still it was a very near approach to it, and there can be no doubt that the merit of his plan, as well as that of putting the finger up in extension after the operation, is due to him. He also recognized the fact that the malady was due to contracted fascia, and not to contraction or retraction of tendons, or inflammation of their sheaths, though Little, as recently as 1870† states that the flexor tendons are implicated in the contraction; and Bryant‡ considers that the flexor tendons as well as the palmar fascia produce the contraction. Lonsdale and Tamplin also held the same view.

Jules Guérin's operation:—Guérin appears to have been the first who divided contracted fingers by the subcutaneous plan, and though he spoke of the necessity of dividing flexor tendons, and stated that he not only obtained perfect union of their divided extremities without adhesions, but that the movement of the fingers was well preserved, he

* "Treatise on Dislocations and Fractures of the Joints." In the chapter on "Dislocations of the Fingers and Toes."

† "Holmes's System of Surgery," Second Edition, Vol. 3, p. 698.

‡ "Practice of Surgery," Third Edition, Vol. 2, p. 323, London, 1879.

undoubtedly adopted the subcutaneous method for the treatment of this deformity.

Sir William Fergusson's plan consisted in passing a narrow knife between the skin and contraction, and carrying it through the most prominent band, whether this be merely aponeurosis, tense cellular tissue, or tendons. The fingers were subsequently gradually extended.

W. Adams's operation :—This consists in making multiple subcutaneous divisions of the fascia and its digital prolongations, and I will use Mr. Adams's words as far as possible : The small tenotome, or fascia-knife, is passed between the skin and the tense band, which is then slowly and cautiously divided, taking care not to dip the point of the instrument or to divide any structures except the contracted band. The operation is better confined to one or two fingers, if many be contracted, and from four to six punctures may be made in different places if necessary. The first puncture is made in the palm of the hand, between the transverse crease and the annular ligament, at a point where the skin is not tightly stretched over the hand, and where it is not adherent to the fascia. The second puncture should divide the same cord as the first, but as near to the finger as possible, between the transverse crease and the web of the finger, thus leaving the contracted band in the palm of the hand, where adherent to the skin, isolated, and cut off from its connexions, on its upper and lower extremities. The third and fourth punctures divide the lateral digital prolongations. These must be divided very carefully, in order to avoid cutting the vessels and nerves along the sides of the fingers. The puncture should be made at the bifurcation of the cutaneous web between the fingers, and the incisions directed obliquely upwards and outwards, towards the palm of the hand. These incisions will divide the strongest and most prominent bands which produce the flexion of the

first phalanx of the finger upon the hand, and if care be taken to avoid dipping the point of the knife, there will be no fear of wounding vessels or nerves.

Sometimes lateral bands and contracted fascia require to be divided opposite the centre of the first phalanx, and this must be done by puncture at the edge of the contracted bands, the knife being directed transversely towards the band; but this cut must be made very carefully, to avoid the artery and nerve, the surgeon remembering that the band, though tough and strong, is at the same time very thin. Occasionally, a lateral band may have to be divided between the first and second phalanx, or one on either side, at a point corresponding to the articulation, and this must be done carefully and with the precautions just described. Central incisions in front of either the first or second phalanx should be avoided, as the sheaths of the tendons, or the tendons themselves, may be readily divided by such incisions, and would, if the finger were put up in complete extension, lead to loss of flexing power.

FIG. 189.—Instrument with cog-wheel arrangement to be worn after division of the palmar fascia.

A pledget of lint is immediately applied over each puncture, and retained by plaister. Subcutaneous hæmorrhage is thus arrested, and the hypodermatic character of the operation is preserved. An additional compress of lint should be applied, and the fingers bandaged to the splint in an extended position.

After division, the fingers are *straightened at once*, the object being to widen the gaps in the fascia as much as possible, with the view of preventing union, and of lengthening the contracted band by intermediate new

material. This proceeding is just the reverse to that we desire to obtain after subcutaneous tenotomy. The splint is not removed until the fourth day, unless there be pain or swelling, when the punctures will be found healed. It is then reapplied, and extension kept up day and night for two or three weeks, the splint being changed every two or three days. After this the splint is only worn at night for three or four more weeks, and *passive* and *active* movements are made use of during the day. I was the first to adopt *immediate extension* after division, and Mr. Adams subsequently followed the practice.

In cases of old standing, and in those in which the second phalanx is sharply flexed upon the first, immediate extension after tenotomy cannot always be carried out. This arises from two causes: first—the difficulty of dividing all the contracted fascial bands in the neighbourhood of the joint, without risk to vessels, nerves, tendons, or even the joint; secondly—the risk of tearing the skin, if immediate and complete extension should be attempted by any forcible manipulation. When the extension cannot be immediately made to the full extent, it must be carried as far as possible without producing pain, or running the risk of tearing the skin. In such cases, resort must be made to gradual mechanical extension, which may be commenced on the fourth day by means of an appropriate apparatus, and even then, should the skin appear thin and shiny, extension will have to be intermitted.

Relapse of the contraction is rare, Mr. Adams says, after this method of treatment, and he thinks that it is prevented by multiple division and by immediate straightening. He has never known more than partial relapse in a few difficult cases out of a large number, and in these, any bands that have escaped division, or any which may have since become prominent by the extension, should be subcutaneously divided, and the disposition to recontraction

prevented at an early stage. This, he says, contrasts very favourably with the relapsed cases after open wound, which from the nature of the cicatricial contraction are incapable of further relief.

I have operated five times according to Mr. Adams's plan, once by also dividing the tendons, and only once by open wound, and I certainly think that the subcutaneous method is undoubtedly, in most cases, preferable to the other; but there are cases in which the entire deformity is only slowly, or after considerable difficulty, cured by it. This difficulty has been met by other surgeons. Goyrand says, that the subcutaneous method gives excellent results where applicable, but it is only so in rare and simple cases in which the retraction is caused by a single band not adherent to the skin, which goes from the point of origin to the point of insertion without sending out secondary bands, but, in the more frequent cases of multiple, intimate, and disseminated adhesions, the plan is insufficient. Broca and Tillaux have had unsuccessful cases. Broca's case was a man aged forty, with gout or rheumatism. He had had contraction of his ring fingers for nine years, subcutaneous division, followed by extension and tearing of the bands, did not admit of complete extension, and inflammation followed. A year afterwards, the contraction returned, and Broca did multiple subcutaneous section, avoiding the tendons, and then obtained nearly complete extension with tearing of the skin. Cicatrisation took place in fifteen days, and when the patient was seen two months afterwards there was a tendency to reproduction of the retraction.* Tillaux's case was very similar. Labbé† has recently had a successful case in a man aged forty, whose ring and little fingers of both hands became simultaneously affected two years previously. The left hand was operated on by Richet,

* Roque, *Thèse de Paris*, 1871.

† Jean Pierre, *Thèse de Paris*, 1882, and Chevrot, *Thèse de Paris*, 1882.

according to Guérin's method and the operation was considered a success, though rheumatic mischief in the joint prevented complete extension. Labbé operated on the right hand, in which the fingers were in a state of semi-flexion, but he did not expect to entirely succeed, and only adopted it, intending to operate according to Guérin's mode latter on. The operation resulted in a success, and he explained it by the fact that the fingers were only in semi-flexion, that they could be straightened by strong pressure, and that the superficial situation of the band facilitated the result.

My opinion is that one should first try the subcutaneous plan, and if, in severe cases, this should fail after a fair trial, then one of the methods by open wound may be adopted, and if care be taken not to interfere with the tendinous sheaths, and to avoid injury to vessels and nerves, excellent results may thus be obtained.

Mr. McHardie of the Manchester Infirmary has, in the first number of the *Medical Chronicle*, advocated a modification of Goyrand's operation and adduces five encouraging cases.

During the last nine months four cases of this malady occurred in my practice at the London Hospital, and were shown to the class. Three of the subjects were young men aged, respectively, nineteen, twenty-three, and twenty-nine, showing that the disease not unfrequently occurs early in life. The last case occurred in a woman aged fifty-two, a washerwoman, who had never had gout or rheumatism. She attributed it to the wringing of clothes, but this could not have caused it. A band existed corresponding to the right ring finger, but on the left there was only a corneous thickening of the skin over the metacarpo phalangeal articulation, and this was perfectly movable on the sublying tissues. It looks as if the disease began in the skin in her case.

CHAPTER XXIII.

JERK, SNAP, OR SPRING FINGER.

Definition.—This malady consists in an obstruction to flexion and extension of one or more fingers at a certain stage of these movements.

Synonyms.—French, *Doigts à Ressort;* German, *Schnellenden oder Federnden Finger.*

Causes.—This affection is sometimes due to injuries, such as contusions, sprains, &c., or it may come on after strong use of the fingers, as in wringing; and may also result from inflammations of the tendinous sheaths. In some cases it is, however, idiopathic. Rheumatism or gout may tend to produce it. I think that in some traumatic cases it may possibly be due to rupture of the tendinous sheath and hernia of the synovial fringe.

Symptoms.—These consist in the inability to completely flex one or more fingers, more commonly the thumb, without, at a certain stage, a resistance, often painful, being felt, and flexion can only be completed by a sort of little jump or jerk. There is often a circumscribed swelling to be felt along the course of the affected tendon, and if the finger be placed along the course of the tendon it will be found that the obstruction almost always occurs near the metacarpo-phalangeal articulation. Flexion having been completed either voluntarily, or with the aid of the other hand forcing the finger into complete flexion, extension

will be found to be obstructed at the same spot, and will be also accompanied by a jerk, and, in some cases, by an audible snap.

Pathology.—Notta* appears to have been the first to have described this affection. In two of his cases the ring-finger, in one the ring and middle finger, and in another the thumb was affected. W. Busch† describes two cases, in one of which, the joint between the two thumb phalanges, and in the other, the joint between the first and second phalanges of the ring-finger were affected. Hahn‡ relates a case occurring in a man aged fifty-five, in whom both ring-fingers, after an unusual long bout of digging, were affected with this malady. Menzel§ records a case of a woman aged forty-two, who felt rheumatic pains, and in whom the thumb became affected. Berger|| relates five cases, all occurring in women of different ages. One aged thirty-four, after repeated rheumatic pains, had the right thumb affected. Another aged fifty, after similar symptoms, had the same digit affected after a long bout of ironing. In the third case, which occurred in a young woman of twenty-one, after severe rheumatic joint affection, the thumb became affected. The fourth case occurred in a woman of sixty. All these appear to have been due to rheumatism, and the condition of the finger followed cold after washing clothes. The fifth case occurred in a girl of five and a half. Several fingers were affected: in the right hand, the thumb, middle,

* *Archives Générales de Médecine*, 1850, Series IV. T. 24, p. 142, &c.

† *Lehrbuch der Chirurgie*, B. 2, p. 143.

‡ "Ein Fall von federnden Finger," *Allg. Med. Centralztg.*, 1874, No. 12.

§ "Ueber Schnellenden (Federnde) Finger," *Centralblatt für Chirurgie*, 1874, No. 22.

|| "Ueber Schnellenden Finger," *Deutsche Zeitschr. für Pract. Med.*, 1875, Nos. 7 and 8.

and ring-fingers; in the left, the ring and little finger. Fieber* describes three cases; one occurring in a man aged seventy-one, in whom the middle finger of the left hand was affected after repeated pressure on it. The second case occurred in a woman aged fifty-two, and followed a fall on the outer side of the left hand. The third occurred in the left ring-finger of a woman aged fifty-eight, apparently after playing for a long time on the clavier. Vogt† describes three cases: one affecting the right ring-finger, the second the right thumb, the third the right middle finger, all three at the level of the metacarpo-phalangeal joint. Felicki‡ describes four cases which occurred in the practice of Prof. Vogt. The first was in a man aged fifty-two, in whom the right thumb was affected after an accident causing hyper-extension. The second in a woman aged fifty-six, occurring in the right thumb without obvious cause. The third in a man whose left thumb became affected after contusion of the same fore-arm. The fourth, a girl aged nine, who, after practising writing, had the right middle-finger affected. To these I can add three cases accurately observed during the last three years, in one of which the right thumb, and in the other the right ring-finger, were affected. One followed a whitlow, and occurred in an instrument-maker, who often had to exercise severe pressure on the ball of his thumb. The case in which the ring-finger was affected was in a woman aged forty, and I could not get any distinct evidence of gout or rheumatism. The last case that came under my notice was in the person of Dr. Gabriel, retired surgeon of the Royal Navy, who has kindly permitted me to use his name. He first noticed his

* "Ueber den sogen. Schnellenden Finger," *Wien Med. Blätter*, Nos. 14–17, 1880.

† "Die Chirurg. Krankheiten der Obern Extremitäten," 1881.

‡ "Ueber den Schnellenden Finger," 1881.

ring-finger stiff after holding a heavy fishing-rod for several hours. The nodule, the obstruction to motion, and the snap when this is overcome, are all well demonstrated in his case. He is about fifty years old.

Bernhardt* has recently recorded two cases, one occurred in a woman aged sixty-eight, and the other in a man aged forty-nine. In both cases the right middle finger was affected, and in both a contraction of the palmar fascia occurred before the symptoms of jerk finger began.

The *pathology* of these cases, in the absence of any dissection, must, in the meantime, remain conjectural; but several probable explanations offer themselves. It appears probable that the sudden and sometimes painful hindrance to motion, at a particular phase of flexion and extension, sometimes accompanied with audible snap, may be due to one, or more, of several changes. We may, I think, dismiss the occurrence of a loose or pendulous body in the phalangeal, or metacarpo-phalangeal joint, as the regularity of the occurrence at a particular spot seems to do away with such an accidental cause; for in such cases, though hindrance might, and probably would occur, during the motions of the joint, it is improbable that it would always recur at a particular stage of flexion and extension. It is true that a fixed prominence, *i.e.* deformity in a joint, might produce these symptoms; but in the cases observed, there were other phenomena, which necessitate quite other explanations. The views of the different writers on this subject vary considerably. Nélaton, who followed Notta, thought that the hard movable body, the size of a pea, which was to be felt in the metacarpo-phalangeal joint, was the cause of this remarkable affection, and von Pitha agrees with him. Menzel experimentally proved Hyrtl's state-

* "Beitrag zur Lehre von Schnellenden Finger," *Centbl. für Neu-krank*, No. 5, 1884.

ment that a circumscribed thickening of the tendon of one or other of the long flexors, with simultaneous narrowing of the tendinous sheath, would cause this peculiar phenomenon. The hindrance to motion occurs just at the spot where the thick tendon enters the narrow sheath; but when it has passed through this channel further motion is free, and just as it has passed through, the snapping sound is heard and felt. Berger agrees with this view. Roser explains this snapping on the supposition that there is roughness of the flexor tendons at the spot where the flexor sublimis pierces the profundus. Lisfranc supposes that the phenomenon is due to a disease of the tendons through the formation of tendinous nodules.

It would appear, I think, most probable that the affection is due to a thickening of the tendinous sheaths, which produces hindrance to the free passage of the tendons at a particular spot; but as the affection appears commonest in the thumb (*i.e.* in twenty-eight cases it occurred eleven times in the thumb, nine in the ring-finger, six in the middle, one in the index, and one in the little finger), and as the anatomical conditions are here different, we must seek another explanation. In these cases the commencement of the affection seems due to a para-articular inflammation of the tendinous sheaths, and especially at the region of the metacarpo-phalangeal joint. The groove in which the flexor longus pollicis runs is at this spot limited by the sesamoid bones, and bridged over by a firm fibrous structure converting it into a canal, and it seems, anatomically, highly probable that the slightest thickening of the tendon, or its synovial sheath, would, at this spot, lead to obstruction in its motions.

In the other fingers there are similar firm osteo-fibrous canals for the flexors on the proximal and middle phalanges, which are strengthened by the transverse and crucial bands.

Here, it is probable, that the hindrance to motion may occur either through thickening of the tendon or tendons, the canal being normal; or through narrowing of the canal, the tendon being normal; but at these spots, in the cases related, the obstruction was not to be felt. It was found higher up in the shape of a circumscribed lump near the metacarpo-phalangeal joint, and, therefore, the obstruction was at a point free from these thickenings of the tendinous sheaths, and this necessitates seeking another cause, to which the normal anatomy of the part will guide us.

If the skin and subcutaneous cellular tissue be carefully reflected from the palmar fascia of a normal hand, and an opening made in it at the level of the metacarpo-phalangeal joint, the close relation of the fascia to the subjacent flexor tendons will be clear. The special arrangement of the synovial sheaths of the fingers is here of importance, and, as is well known, in the majority of cases, the tendinous sheaths of the three lesser fingers are limited by *culs de sac* at the metacarpo-phalangeal line, and at this spot the *vincula vaginalia tendinum* are attached to the tendons, and on moving the fingers, there will be seen to move with them delicate vascular folds, the so-called *meso-tena*, or synovial fringes. In flexion and extension these processes are pushed up and down, and there can be little doubt that any change of these parts interfering with the free motion of the tendons, will produce obstruction to flexion and extension, and especially will this be the case at a certain stage of motion, when the synovial folds pass underneath the transverse process of the palmar fascia. In extension, the synovial sheaths pass decidedly under this fascia, in flexion, they pass towards the wrist, and this can be seen by making openings in the palmar fascia, so that one can understand that, partly through thickening in the transverse process of the palmar fascia, partly through a rolling up or displace-

ment of the processes of the synovial sheaths, a block in motion may occur, and it is just at this precise spot that the hindrance and swelling have often been observed. It would thus appear that it is not in the joints, nor in the phalangeal portions of the tendinous sheaths, that this obstruction is to be sought, as a rule.

Moreover, the manner in which some of the cases arose lends support to this view. As sometimes through injury, and at others without, but accompanied with rheumatism, a circumscribed nodular swelling, which may have been either an intra-vaginal blood extravasation, or a little rent in the affected portion of the palmar fascia, with subsequent thickening, occurred; and as in others, pressure-contusion or sprain may have given rise to changes which produced a narrowing at the spot mentioned, the joint theory may be excluded, though any thickening or irregularity of the tendon, or its serous sheath, would produce the symptoms; and the more the thickening of the fascia or tendon, the more marked will be the hindrance to motion at a particular phase.

In the thumb, as previously remarked, the anatomical conditions are different, as the synovial sheath of the flexor longus pollicis passes without interruption into the common sheath. In some of the cases, the injury or disease seemed at first to affect the joint as well as the tendon; but after treatment the joint motions became free, while the hindrance to flexion and extension could be felt on the palmar aspect of the thumb at the metacarpo-phalangeal joint. In some cases, a thickening could be felt and great pain at this spot, while the other joints were free, so that a circumscribed affection at this spot must have been the cause. A thickening and consequent narrowing of the canal at this spot seems to be the only explanation; but whether it was due to thickening of the synovial capsule, or

of the ligaments, or of the synovial process, cannot be decided without direct examination. It would, therefore, appear that not only is there a disproportion at a certain spot between the size of the tendon and its canal, *i.e.* a stricture of the tendinous sheath, on the one hand, with or without circumscribed thickening of the tendon on the other; but that often it may be due merely to a thickening of the vaginal processes, which become stopped as they pass under the transverse bands of the palmar fascia; and there may also be a thickening of the latter, while the synovial processes remain intact, while in the thumb, the mischief occurs at the metacarpo-phalangeal joint.

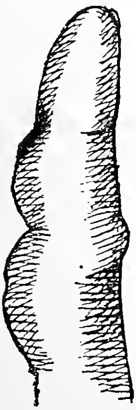


FIG. 190.—Ganglion of flexor tendons of index.

Pathogenesis. — How these various changes are produced one cannot positively say, but that they follow injuries, and occur in rheumatic subjects, there is no question. It may be that a rupture of some of the tendinous fibres may produce thickening, or it may be that the injury or disease may produce tendo-vaginitis, and so cause enlargement of the synovial fringes. It may be that small ganglia are formed in these tendons, and I have, on two or three occasions, opened such, on the palmar aspect of the fingers. In one case (see Fig. 190) it was so large that flexion was impossible until the sac had been emptied. There may be partial adhesions between the tendons and its sheath at certain spots, and after certain injuries or diseases, and again, it may be, that in elderly people, small sesamoid cartilages may form in some of these tendons, as we find them occasionally in the peroneal tendons and elsewhere. Roser's view that this affection is due to a thickening at the place where the profundus pierces the sublimis would

appear to be a rare cause, as the seat of obstruction is, as before said, found higher up, and seeing that such an anatomical condition is absent in the thumb, unless we regard the passage of the long tendon through the tendons of the short as analogous to it, we must, in any case in which obstruction is felt to be at this spot, look rather to the synovial folds attaching the tendons to the phalanges as more likely to be affected, than the tendons themselves.

Prognosis.—This will depend upon the cause and upon the time at which the case comes under observation. In traumatic cases, blood extravasations may become absorbed, and the hindrance to motion vanish. Partial rupture of tendons may unite without excessive effusion; or, if this have formed, it may become absorbed and the malady disappear. In rheumatic cases, the prognosis is not usually very satisfactory. In cases of tendo-vaginitis, whether traumatic, primary, or secondary to tubercular affections of the phalanges or their joints, the prognosis will depend upon the amount of mischief which has occurred at the time the case is brought under observation.

Treatment.—Patients suffering from this affection, seeing that it interferes with the use of the members by which most of us earn our bread, are most anxious for relief, for it is not only the affected digit, but the whole hand which is hampered in its usefulness. If a sprain or hurt have produced it, or have caused tearing of tendon fibres, cold applications, and fixing the fingers in flexion until union has taken place, should be adopted, and when tenderness of the part has subsided, frictions and passive motion may be resorted to; but in such cases, thickenings of the synovial fringes, or fibrous deposit, or adhesions, are apt to form. Elastic compression and massage are of service, as was proved in my cases. In rheumatic cases, a similar treatment, combined with medical means, must be adopted; but if in

any of these cases, after a good trial has been given to the methods mentioned, the hindrance should persist, and a thickening or nodule be clearly felt to produce the obstruction and pain at a particular spot, this must be dealt with by operation. If it be a ganglion, subcutaneous puncture with friction and pressure may cure it ; but if there be callosities, or fibrous or connective tissue thickenings, a longitudinal incision through the thickened spot should be carefully made, the skin held apart, the adhesions separated and circumscribed thickenings excised. Faradization, strong, voluntary or passive motions of the tendons, if not too painful, and if painful, under an anæsthetic, may be resorted to, and succeeded in some of Berger's cases. This plan may be adopted either before or after incision, if necessary. Antiseptic precautions should be used by those who think them desirable.

PART V.

ANCHYLOSIS AND OTHER DEFORMITIES.

CHAPTER XXIV.

ANCHYLOSIS AND UNREDUCED DISLOCATIONS.

Definition.—This deformity consists of stiffness of a greater or less extent and resistance in a joint or its neighbourhood, and is commonly the result of inflammatory changes.

Synonyms.—Greek, ἀγκυλος crooked or hooked, ἀγκύλη bent: English, *stiff-joint, fixed joint:* French, *roideur articulaire;* German, *Gelenkverwachsung.*

Varieties.—These are the *osseous* and *fibrous*, the former being termed *true* anchylosis and the latter *false*. Anchylosis may also be *extra* or *intra-articular*, and either the true or false forms may be chiefly peripheral, or mainly central. *Complex* or *combined* anchylosis is that form in which pathological dislocations, whether complete or partial, occur. *Spurious* anchylosis is due to stiffness of the muscles, tendons, and ligaments, without pathological change, and is generally caused by long continued rest in one position. It may also be due to cicatricial contractions of the skin and subcutaneous tissue, as after burns, &c., or to extra-articular exostoses. Osseous and fibrous anchylosis may be *partial* or *complete.* Osseous anchylosis is also termed *synostosis.* Either form may be *congenital* or

acquired, the former being rare. In congenital anchylosis the joint surfaces are generally more or less deficient or absent. Fibrous anchylosis is far commoner than bony, and, as a rule, more frequently met with in young, than elderly people, as joint disease, not rheumatic or gouty, is more common in them.

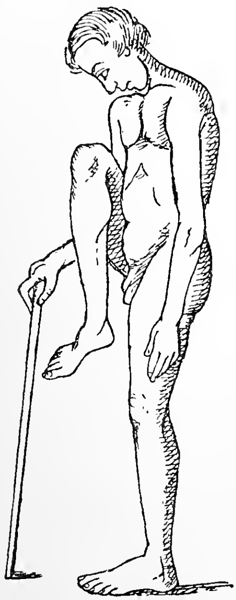


FIG. 191. — Severe false anchylosis of hip and knee after rheumatism, which was successfully straightened at one sitting by manual force.

Causes.—Diseases of the joint producing, or originating in inflammation, whether traumatic or spontaneous, are the most common causes. The inflammation may have a tubercular, or strumous, rheumatic, gouty, syphilitic, septicæmic, scarlatinal, puerperal, or nervous origin. Gonorrhœal rheumatism is also a somewhat dangerous cause of the affection. Long continued pressure will, of itself, produce erosion of cartilages, and bony anchylosis, as in severe cases of lateral curvature, and in some old and bad cases of varus or flat foot. Inflammatory œdema around joints, if it become organized, will lead to the extra-articular forms of the malady. Long continued rest or fixation in a particular position will produce considerable stiffness of joints, and though some French writers are inclined to question this, no experienced surgeon can, I think, doubt its occurrence. This variety is usually of the *spurious* form, *i.e.*, due to stiffness of joints and ligaments without marked pathological change, though undoubted cases of fibrous anchylosis have occurred from this cause, and, as

will be presently seen, a case of bony union has been recorded by Teissier. Sir James Paget* and Butlin† have drawn attention to cases of this nature, as have also several German and some French authors, among whom may be mentioned Menzel,‡ Reyher,§ and Teissier,|| and Jacobson,¶ quoting Teissier, says that long continued rest causes:—1. "Escape of blood or serum into the cavity, into the subsynovial cellular tissue, or into the soft parts outside the joint. 2. Vascular injections of the synovial fringes, with formation of false membranes. 3. Alterations of the cartilage, *e.g.*, swelling, softening, and erosion. 4. Anchylosis; this is shown to be not only frequently fibro-cellular, but in one case, at least, where the thigh was amputated for non-union of a fractured femur after twenty-two months of extension and immobility, it is proved that actual fusion of contiguous articular surfaces may take place." Teissier thought that prolonged immobility of a joint caused a suppression of the synovia and engorgement of the articular structures, and these observations are confirmed by Menzel. Reyher states that in cases where immobility has been occasionally interrupted, ulceration of the joint cartilages may occur. It must, however, be borne in mind, as pointed out by Jacobson, that there are certain sources of fallacy which must not be overlooked, *e.g.*, in cases where prolonged rest has been necessitated, by an injury to a limb, such as fracture, or dislocation, the primary injury may have set up articular mischief which was unnoticed at the time, and I would add that there need not have been original injury to the joint, but changes may have extended to it along

* "Clinical Lectures," Second Edition, 1879, p. 213.

† *Path. Soc. Trans.*, Vol. 25.

‡ *Arch. für Klin. Chir.*, B. 12.

§ *Deutsche Zeitschrift für Chir.*, B. 3.

|| *Gaz. Méd.*, 1841.

¶ "Hilton's Lectures on Rest and Pain," Third Edition, p. 321.

the periosteal or medullary vessels, for we know that in some cases of fracture of the femur, or even of osteotomy at the junction of the middle and lower femoral thirds, even after plaster-of-Paris is at once applied, a temporary effusion into the joint cavity may occur, and though this is usually

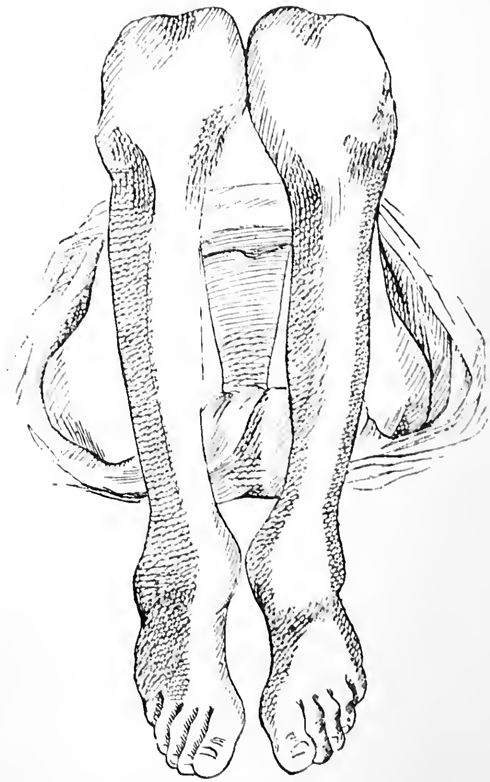


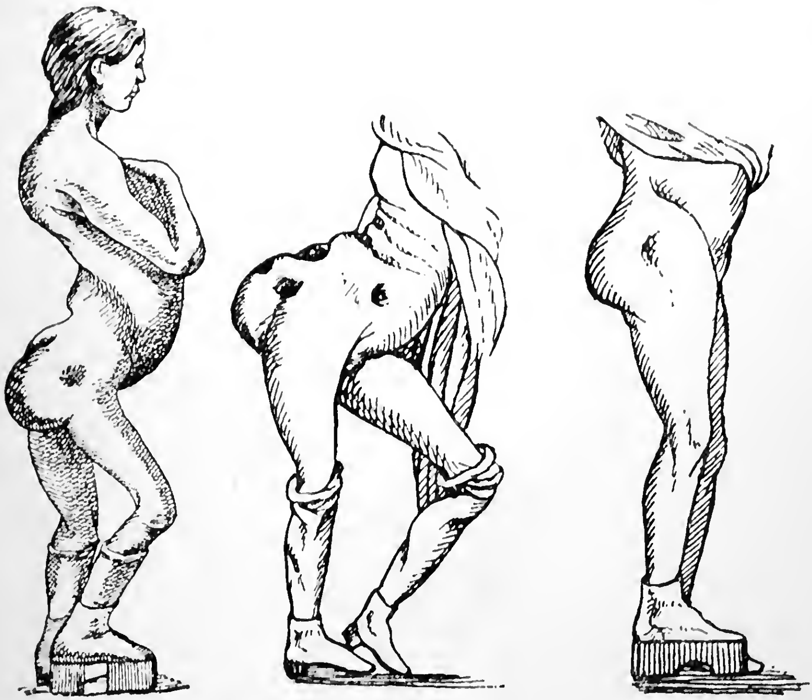
FIG. 192.—Rheumatic anchylosis of knees. Inflammatory mischief being present and other joints affected, nothing was done.

absorbed there may, in individual cases, be some constitutional or local predisposition to a continuance of inflammatory action, leading to fibrous or osseous anchylosis. Dr Bruce* has shown the proneness of certain joint

* *Path. Soc. Trans.*, Vol. 20.

cartilages, after young adult life, to show signs of commencing degeneration.

Pathology.—The *fibrous form* is due to the effusion of inflammatory products either around or into the interior of joints, or both, and to the organization of this effused



FIGS. 193, 194, and 195.—Scrofulous bony anchylosis after morbis coxæ. Lower umbar cured Pott's disease. The left hand figure shews the patient before operation standing in her boot; the middle figure represents her standing in ordinary boots on the affected leg; the right hand figure is how she was six weeks after operation.

material. Lymph exudes into the connective structures in and about the joint and along the sheaths of the tendons and muscles, and the parts are matted together in a defective position, so that the movements are consequently impaired. In the intra-articular form, the cartilages are united by adhesions which sometimes become firm and strong, and

cases are known in which spicules of bone have been found in the fibrous bands, external or internal to the joint, and, in some cases of severe injury or inflammation, the fibrous tissue may organize into bone, but a good deal depends upon the manner in which the joint has been treated. If absolute rest, with other proper methods, have been adopted in an early stage, these adhesions are not firm, but if the joint have been allowed to become fixed in the usual flexed position, the articular surfaces are no longer in their proper relations, and the resulting contraction of tendons, ligaments, and fascia about the joint are generally of a more obstinate nature. This form of anchylosis may also be due to adhesions between the walls of the synovial sac, which are formed in the direction to which the limb is bent. It may also be caused by cicatricial contraction of the joint-capsule and surrounding ligaments.

The *bony form* is due to erosion of the joint cartilages and the junction of the articular ends of the neighbouring bones, and though, in some rare cases, this may occur after *dry inflammation* of the joint, the rule is for the inflammation to end in the formation of pus with destruction of the joint structures and the gradual disintegration, elimination, or absorption of necrosed portions of cartilage and bony *débris*, before synostosis occurs. The position in which bony union takes place will vary according to the manner in which the limb has been treated. In some of the cases, impediment to motion is due to unevenness of the remaining cartilaginous surfaces, and, in others, to stalactites of bone formed in the erosion-places between the cartilage which has been spared. Another cause of bony anchylosis is in the ossification of articular cartilages, and Volkmann has described this *cartilaginous anchylosis*, which occurs commonly after suppurative subacute coxitis, in young people, and it may also occur in the knee,

elbow, or ankle. Billroth considers the name well chosen, because the cartilage remains long intact. In some cases of rheumatic arthritis and arthritis deformans, bony deposits form in the joint and hinder its movements. These are *mechanical* obstructions of a different kind, as the limitation of motion is prevented by the meeting or locking of these new processes, and not to the union of adjoining articular surfaces.

It will be well to separately describe the changes as they affect each articular constituent, commencing with the *bones*. If an average joint, *i.e.*, one not in the early or in the later stage, be examined, one finds that the articular surfaces are roughened, dry, deformed, and more or less closely united, and very often the cartilages and fibro-cartilages are swollen, softened, and velvety, and have disappeared in parts. Sometimes there are isolated sequestra, which may be undergoing absorption, or may even ossify and assist in the anchylosis. The bony articular ends are more or less deformed and displaced, and if the malady have been untreated, there will be a partial displacement of the articular ends, according to the direction of the disease and the power of the opposing muscles. In the *knee*, which is so commonly affected, the tibia is often displaced back and outwards, and its articular end is in contact with the posterior part of the femoral condyles, which form a marked projection anteriorly. The transverse diameter of the lower end of the femur is relatively, and often absolutely, diminished, and the femoral tuberosities, to which the muscles are attached, are atrophied. The long diameter of the lower end of the femur is increased, as was first pointed out by Bonnet,* and afterwards by Gosselin,† and this has been recently studied by Volkmann.‡ In such

* "Traité des Sections Tendineuses."

† *Clinique de l'hôpital de la Charité*, T. 2, p. 168.

‡ *Berliner Klin. Woch.*, 1874, p. 629.

cases that portion of the femur, which, in consequence of flexion of the leg, has been relieved from the pressure of the tibia and of the body-weight, increases in length, so that a longitudinal section through it forms half an ellipse. If this be not borne in mind, such a case may be mistaken for a dislocation backwards of the tibia, and a glance at the accompanying figure will suffice to show that reduction is next to impossible. The tibia is often connected to the

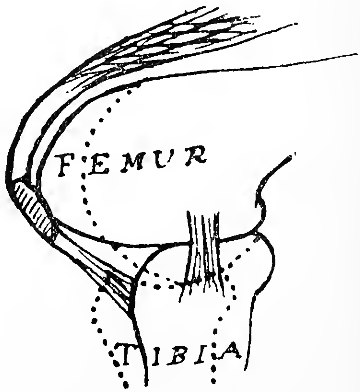


FIG. 196.—Diagram, after Volkmann, to shew the lengthening of the lower end of the femur in chronic arthritis.

femur by fibrous bands. These are sometimes soft and at others very firm.

At a later stage, or in severe and acute cases at an earlier period, the bones are fused, or connected by an intermediate layer of bone. Ordinarily, this ossific change proceeds from the periphery to the centre, and, if the joint be ginglymoid, the process commences usually at the convexity, and later on is most active at the concavity, so that when the pathological process is complete, the osseous tissue is more compact in the latter situation. The laminæ of the epiphysial spongy tissue are displaced towards the

periphery, and form a compact layer, joining the bones, and in some cases the medullary canals of the two bones are continuous ; but this is not the rule, as commonly there are distinct traces of demarcation between the two bones. In some cases the union is merely by stalactitic processes.

The patella may be displaced or firmly adherent to the condyle, and it is most commonly joined to the external condyle, but sometimes to the internal, and occasionally it is fixed to the inter-condyloid notch. Foucher* relates a case in which it was united to the external condyle by bone along its upper half, and its apex was joined to the tibia by an osteo-cartilaginous bridge. Sometimes this bone undergoes rotation, so that one of its borders is prominent, and its articular surfaces inclined anteriorly. In other less common cases the adhesions are around the patella, and form the chief obstacle to movements; and these cases, in which the anchylosis is due solely to the patella, appear to be oftenest due to injury or gonorrheal rheumatism. In scrofulous and rheumatic cases, the new bony tissue is more friable or flexible, as a rule, and in some cases the cancellous spaces are enlarged, while in others they are condensed.

FIG. 197. — To shew the position of the bones in a case of bony anchylosis at the knee.

The *synovial membrane* is always more or less thickened, especially in chronic inflammations, and is a powerful factor in the immobility of the bones. The degree of the thickening varies, being sometimes universal, at others only in patches. In the *shoulder*, the sub glenoid fold is that which

* *Bulle'in de la Soc. Anat.*, 1855, p. 473.

prevents abduction of the arm, and in the *knee* the supra-patella pouch is folded and adherent. Duret* compares the evolution of the fibrino-plastic synovial products due to arthritis from colds, to the false membranes of fibrinous pleurisy, and points out the powerful resistance that these adhesions ultimately form. Hueter† states that the firmness of the marginal adhesions is opposed by the softness of the central ones, which are due to delicate vascular prolongations from the granulation tissue formed at the expense of the cartilage, the peripheral adhesions being formed by the synovial and peri-synovial tissues, which render them always strong.

The *ligaments* are changed in structure, and often in direction, and in some cases have undergone bony change. At first there is a sero-gelatinous infiltration in the interstitial cellular tissue which invades the fibrous laminæ; causing them to swell and lose their glistening aspect. They become soft and transparent, and, microscopically, show abundant cell proliferation, so that a tissue is formed similar to cicatricial tissue. In dissections, it is often difficult to recognize them and make out their attachments. The thickening of some ligaments, and especially of the posterior ligament of the knee, and the anterior of the elbow, is due to changes in the ligament itself and to its synovial lining, as well as to changes in the peri-articular cellular tissue. Sometimes ligamentous changes are slight while the joint functions are almost abolished, so that while ligaments may be normal to the naked eye, attempts at rectification show them to be very resisting, or to become ruptured. The ligaments, as already stated, may also ossify, forming isolated plates, stalactitic growths, or dense masses of bone; and veterinary surgeons are familiar with a form of anchy-

* *Bulletin de la Soc. Anat.*, 1872.

† *Klinik der Gelenkkrankheiten*, B. 2, S. 270, 1876.

losis forming a ring around the articulation. Movement is of course impossible in such cases, and if a vertical section be made through a joint anchylosed peripherally, it will commonly be found that the other joint structures are intact, or there may be present those changes in the synovial membrane due to prolonged immobility.

The *extra-articular* structures are also involved. The *cellular tissue* about a joint, especially in front of the elbow and back of the knee, may become thickened and fuse with the adjoining ligament so as to form a sort of fibrous callus ; and it must be borne in mind that this tissue is like cicatricial tissue, and, being but little extensile, it tears or breaks. The *tendons* are often united to their sheaths, and these are glued to the surrounding joint structures. The *muscles* are altered in structure, size, and shape. They are wasted, contracted, and fattily degenerated ; but in cases where slight motion remains, they may be normal, or some part of the degenerated muscles may have retained a portion of their elasticity and extensibility, and it is to these that the rarity of muscular rupture, in forcible reduction in the more fragile forms of bony anchylosis, is due. The *aponeuroses* around joints become fibrinously degenerated and contracted, and this is especially the case with the capsule and expansions in, around, and at the sides of the knee. The subcutaneous cellular tissue is thickened, indurated, and closely adherent to the skin, and to the deep fascia, so that all mobility has frequently disappeared from it. The *skin* is stretched and thinned, and sometimes traversed by dilated veins.

The *vessels* and *nerves* are most affected in the ginglymoid joints, and in the first instance they are relaxed, in consequence of the flexion of the limb ; they then become retracted, and sometimes to such an extent that any attempt to straighten the limb results in their rupture, but this is

rare. They may be tortuous, and then extension does not harm them, unless their walls have become degenerated. In some rare cases, as in a case of knee anchylosis related by Chassaignac,* the popliteal vessels were away from the joint, and were strongly stretched in a straight line, so that they would surely have been ruptured in attempts at extension.

If anchylosis be acquired at an early age, the development of the bones forming the joint may be interfered with, but usually there is no great change in their length, though the limb is less developed, and this may probably be due to lack of use. When the *epiphyses* are affected, however, arrest of development occurs, leading to inequality of the length of the bones of the affected limb, and to corresponding non-development of all its structures.

The chief pathological changes have now been given, it only remains to recollect that all may be present, but more commonly only some of them are met with, so that sometimes, only peripheral lesions occur; at other times, synovial and articular surfaces are affected, and this has led to varying classifications; but it seems to me that for practical purposes one should recognize not only fibrous and bony anchylosis, but complete and incomplete union. The latter may be *loose* or *firm*, and is diagnosed by the amount of movement permitted. The following arrangement is a serviceable one:—

1. Anchylosis may be *complete* and *loose*, and the pathological changes in such cases are various. There may be osseous or fibrous bands, thickening and partial adhesion of the synovial membranes, thickening and induration of the ligaments, or retraction of one or more ligamentous bands, and a slight deformity of the cartilaginous surfaces. The extra-articular structures are little or not at all changed.

* *Bulletin de la Soc. Anat.*, 1839.

2. Anchylosis may be *incomplete* and *firm*. The pathological changes will depend upon the nature and cause of the pre-existing joint mischief. There may be a firm, dense, fibrous intra-articular band or bands, or an extensive peripheral induration, with ligamentous changes or alteration in the joint surfaces. The extra-articular structures are more or less changed.

3. The anchylosis may be complete, and may be fibrous or bony. If the former, the union is usually very firm; if bony, the union may be central, peripheral, or entire. The articular cavity has disappeared, and there is a peripheral sclerosis of the soft parts which often extends to the integuments. Muscular degeneration is always present.

The processes preceding anchylosis, and determining the direction in which the limb may be fixed, require a little consideration. The pathological changes have sufficiently been given, but the position of the limb is determined, partly by the mechanical construction of the joint, and partly by muscular action. In the *shoulder*, anchylosis is almost always observed with the arm in a line by the side, and for the reason that the weight of the limb relieves inter-articular pressure, because the muscles passing from the trunk to the humerus before and behind the joint are about equally balanced, so that there is but little displacement, and, if so, this is usually in the direction towards the mid-line. At the *elbow*, flexion is determined by the biceps and brachialis anticus, though, in some cases, anchylosis occurs in a straight line, and then is due to this position being the easiest for the patient; and it will be found in such cases, that the anterior part of the joint is more involved. At the *wrist*, the hand is fixed usually in a position between flexion and extension. At the *hip*, the muscles passing along the front and inner side of the thigh produce adduction and flexion, the position most com-

monly met with, and which must, I think, be due not merely to the supposed predominant action of these muscles, but also to the relief and relaxation this position gives to the articular structures.

In the *knee*, flexion and rotation of the leg, displacement of the patella, and partial dislocation of the tibia, are often met with. Semi-flexion and rotation, commonly outwards, but sometimes inwards, results, if the limb have been left to itself, for in this position the ligaments are most relaxed, and the articular cavity acquires its greatest capacity. Tibial displacement is common, and usually occurs backwards, or backwards and outwards, though the bone may be displaced forwards or laterally, this being rare. Bauer* describes a case of retro-curvation due to osseous anchylosis of the right knee following a punctured wound. Grant, of Canada, records a similar case, the specimen is in the St. Louis Museum. Albert has also related some interesting cases, and I have photographs of three interesting cases, in one of which the malformation was due to tabetic arthritis, in one to rheumatic arthritis, and in another to gout. These are instances of backward dislocation, in which an angle open in front is formed at the knee. A similar condition, the result of paralysis, is figured in the next chapter. This sub-luxation is due to the flexors being no longer counter-balanced by the extensors, so that they draw the upper end of the tibia behind the femur, and the mutual pressure of the bones alters the shape of the articular surfaces, so that they no longer accurately correspond. But in some cases, subluxation is impossible, *i.e.* when the muscles are degenerated or adherent to their sheaths, or when numerous firm fibrous bands unite the articular surfaces and the tendons to their sheaths, and bones. For luxation to occur, the

* *St. Louis Med. Journal*, Vol. 6, p. 503, 1869.

ligaments must be changed in their structure and shape, so that they can no longer maintain the bones in place. The muscles are then free to act, and as the extensors are attached to the patella, which becomes fixed to the external condyle, the force of them is lost on the condyle, so that the flexors, which pass to the tibia and fibula, being no longer resisted by the prolongation of the extensors through the ligamentum patellæ to that bone, draw the tibia backwards, and if back and outwards, the latter is chiefly effected by the biceps, and favoured by the smaller prominence of the external condyle. If the joint surfaces be not deformed, flexion and external rotation may exist, and there may be a thickening of the tibia at its upper epiphysis, but sub-luxation is uncommon.

The extra-articular structures in such cases undergo most of the changes previously described, and offer serious obstacles to reduction. The relative power of these circum-articular structures has been experimentally determined by Busch,* and he has shown, by the results of experiments on three cases, that the soft parts offer powerful resistance to reduction, and that the skin offers a greater resistance than the flexors, so that tenotomy is often useless. The most important of the resisting factors is the fibrous tissue around the joint, and this tears in attempts at reduction. This may also contract so as to compress the vessels and nerves, leading to atrophic changes of the leg; and this is sometimes so strong, that attempts at reduction may end in fracture or separation of epiphyses, rather than to its yielding. At the knee, this fibrous thickening is commonest in the popliteal space, but sometimes the aponeurotic expansion at the front and sides of the knee becomes indurated and thickened, and so resists further flexion, though tending

* "Beitrag zur Kenntniss der Contracturen in Hüft und Knie Gelenke," &c., *Arch. für Klin. Chir.*, 1863.

to fix the limb in its defective position. These expansions are torn in the movements of flexion and extension in forcible reduction, as is shown by the intense pain complained of by the patient about the patella after the operation.

At the *ankle*, anchylosis usually occurs in the extended position, or, in equinus, if the limb have been left to itself. This is due to the weight of the anterior portion of the foot, and to the action of the gastrocnemius and soleus, and also to the fact that extension relieves the joint surfaces of a large amount of pressure. If the limb has been put up in a splint with a rectangular foot-piece, the anchylosis will then, of course, be rectangular.

Symptoms.—These consist in more or less loss of the normal motions of the affected joint, and consequent wasting of the limb. The limb will be deformed and shortened, and the subject will walk lame. In the fibrous forms, the patient occasionally complains of pain after use of the limb, and if the lower limb be affected there will not only be shortening of the limb and contraction of its muscles, but if this exist for any time, and be uncompensated, a tilting of the pelvis, followed by compensatory lateral curvature, will result. Objective examination shows not only deformity varying in degree and kind, but also great restriction to passive motion, and alteration in the shape and relative position of the joint structures. *Secondary* or *compensatory* deformities of the spine and pelvis usually result, and if the anchylosis have occurred at an early age, these may lead to aggravated deformity.

Diagnosis.—The difficulty is in differentiating the various kinds of stiffness, and also the nature of the morbid change existing in the joint. Joint-stiffness may be due to existing inflammatory changes causing reflex contraction of the

muscles and circum-articular joint structures. It may also be due to a voluntary fixation of the joint, as in cases of hysteria and malingering. Pain on movement may be due to inflammation, or if the inflammatory process have subsided, it may be due to the stretching of adhesions, or if there be partial dislocation, it may be caused by stretching of the ligaments and tendons. If an anchylosed joint be moved without anæsthetics, and pain be complained of, the presumption is that the union is not bony, especially if the pain be felt on the side *from* which the limb is being forced. In distinguishing whether fibrous anchylosis be chiefly intra- or extra-articular, the character of the inflammation is of some service, as to whether it has been acute, sub-acute, chronic, strumous, gonorrhœal, &c. In these forms the adhesions are commonly *in* the joint, whereas in rheumatic or gouty cases they may be *within* or *without.* In the scròfulous, tubercular, and in some severe syphilitic forms, or after bad injuries to the joint, bony anchylosis may occur; but this form, it must be borne in mind, is far less common than fibrous anchylosis. Osseous anchylosis is commonest in ginglymoid joints, as in the knee and elbow. It is not, however, very uncommon in ball-and-socket joints, as evidenced by the hip; but as this joint is so commonly inflamed, and as some cases are neglected, or refuse appropriate treatment, cases of bony anchylosis are not very infrequent in a large surgical and orthopædic experience. The shoulder and jaw are rarely affected with bony anchylosis, though the fibrous forms are not very uncommon.

Immobility of a joint does not of necessity point to bony union, and in cases of doubt, and before any operation is undertaken, an anæsthetic must be administered. It will be found that in the firm fibrous forms there is a degree of *elasticity* not met with in bony union. There is

less difficulty in examining the distal joints, such as the elbow, wrist, knee, and ankle, than in the hip and shoulder joints, for in these, the mobility of the scapula and lumbar spine, if not duly allowed for, add to the diagnostic difficulties. If an anæsthetic be not given, attempts to move the joints will produce reflex muscular contractions ; and it has been stated that some of these muscular movements show that there is some movement in the joint, but it must be recollected that muscles often pass over more than the affected joint, and that the patient may contract such muscles independently of there being any movement in the joint. It is also stated, that during percussion the patient feels a greater shock in cases of bony anchylosis. This *relative* symptom is due to the absence of the fibrous processes between the joint-surfaces, which act as pads, and thus diminish the vibration, whereas, in bony continuity, the vibrations are continued upwards.

In examining all joint cases great care and gentleness should be adopted whether an anæsthetic be used or not, for even if only the remains of active inflammation be present, or have but just subsided, rough measures may produce considerable damage, and, at best, can only cause needless suffering. I have seen too many cases in which so-called bone and joint-setters, have done most serious mischief, by their ignorant proceedings in such conditions of things.

Prognosis.—This will depend upon the joint affected, upon the cause and stage of the disease, and upon the nature of the material causing the stiffness. In most fibrous forms, especially if there be no luxation, an useful, if not a perfectly strong limb, may be hoped for, particularly if the general health be sound enough to permit of attempts at motion being restored. In cases complicated with partial luxation, and in the bony forms, operative

measures hold out prospects of considerable relief, and I have operated on many cases, and other operations have been recorded by various surgeons, in which the deformity was considerably remedied, and a useful member restored to the patient.

Treatment.—Though we have now only to deal with accomplished anchylosis, it may be well to remind the reader of certain *prophylactic* measures necessary in the earlier stages of joint disease. The position of the affected part must depend upon the vocation of the patient, but as a general rule, the *hip* and *knee* should be fixed in slight flexion without adduction or abduction. The *ankle* should be allowed to become firm at right angles to the leg. The *shoulder*, in consequence of the great mobility of the scapula and clavicle, may be allowed to anchylose in a line with the body, or with the lower end of the limb slightly anterior to it. The *elbow* should, as a rule, be flexed enough to enable the hand to reach the mouth, and the fore-arm should be mid-way between pronation and supination.

There are five plans which may be followed in dealing with this deformity, (1) *gradual extension* by weights or instruments, (2) *rapid forcible correction*, (3) *osteotomy* or *osteectomy*, (4) *osteo-* or *artho-clasy*, and (5) *subcutaneous* or *open division* of adhesions. But before undertaking any operation the questions to decide are:

1. How to remedy the inconvenience caused by immobility.

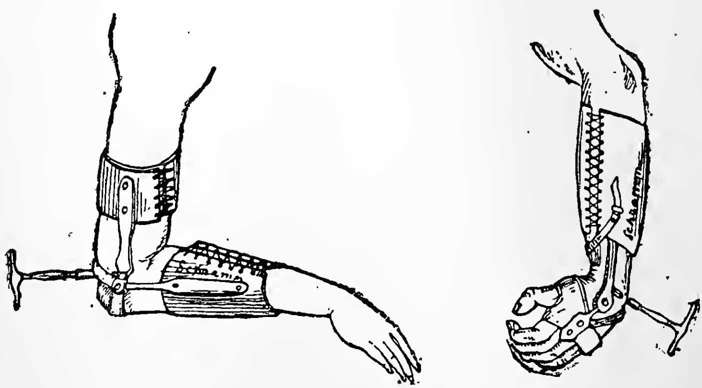
2. The proper method to adopt in any given case.

3. The advantage to be derived by any operation.

4. The nature and extent of the operation necessary to correct or remedy the deformity. And

5. The indications and contra-indications for the various methods.

All these will vary according to the nature of the anchylosis. If it be fibrous and soft, instrumental or manual means will suffice; but if it be fibrous and firm, it may be necessary to resort to gradual or rapid mechanical reduction, or even to osteotomy or osteectomy. In bony anchylosis, osteoclasy, arthroclasy, osteotomy, and excision have all to be duly estimated. *Mechanical extension* may, without any operative procedures, be of undoubted service in suitable cases, and may be executed by splints with cog-wheel joints producing gradual extension, or by one of the



FIGS. 198 and 199.—Instruments for the gradual correction of elbow and wrist anchylosis.

modes illustrated by the accompanying figures, which sufficiently explain themselves, more rapid reduction of the deformity may be accomplished.

Forcible Correction of Anchylosis.—*Brisement forcé*, or *Redressement brusque.* This may be *repeated* or *entire*; the former consists in partial rupture of adhesions at different sittings, and the latter; in correction at one operation. It may be attempted in cases of fibrous anchylosis if all active inflammation have ceased; but in scrofulous cases, not for some considerable time after inflammatory

mischief has subsided, and the general health of the patient must of course be good. In such cases it is well to recollect that in young subjects an epiphysis may be separated, or the adhesions may be so strong that a fracture may result; but as the former has occurred to me in two or three cases, with good correction of position and a serviceable limb, and as I have had the opportunity of watching the cases for some years, and observing that no noticeable defect in the growth of the limb occurred, I do not think that this accident, if occurring in adolescence, is of the serious import some would impart to it; though it must be stated that Bauer* had to amputate in a lad of sixteen for such an occurrence, and that in delicate or growing children, epiphysial separation may lead to inflammatory mischief. Preliminary to manual or instrumental reduction tenotomy may be necessary, and my colleague, Mr. Brodhurst, adopts this plan almost invariably. I have already pointed out that in certain pathological conditions of the knee it is useless, but there are other cases in which such a proceeding is undoubtedly serviceable. Brodhurst states† that cicatrices, tense fasciæ, and contracted tendons should be divided and the punctures allowed to heal before forcible means are adopted, then moderate force, generally manual, is to be used, after the muscles have been thoroughly paralyzed by an anæsthetic. The adhesions should be ruptured first in the direction of flexion and then in extension; but Bauer considers extension safer than flexion. I would advise that in children and adolescents, the hands of the surgeon should be close to the joint grasping the bones near their epiphyses. This plan will prevent, in the majority of cases, separation of epiphyses, whereas, if the further end of the limb were grasped the

* "Orthopædic Surgery," New York, 1868.

† "Anchylosis and its Treatment," Second Edition.

long leverage, giving greater power, might lead to epiphysial separation. After the adhesions have been broken down, Brodhurst recommends that no attempt should be made to directly correct the position of the limb, but that it should be fixed, in its original deformed position, in some splint or apparatus, and that the joint should remain at rest till all tenderness has ceased, when passive movements daily, or every second or third day, should be resorted to, or at longer intervals if necessary, and if these cause pain, hot fomentations or local hot-air baths may be necessary, and, if any tendons have been divided, subsequent extension must be very gradual to prevent their being over-stretched. In rheumatic cases, muscular rigidity is more difficult to conquer, he says, than the anchylosis itself. The difficulty, in my opinion, in such cases is not to correct the deformity, neither is there any great risk in doing so, as I have repeatedly operated in such cases with impunity; but the great difficulty consists in getting a movable, firm, and useful articulation, as there is always a great tendency to *refixation*. In hospital practice, I have applied an ice-bag after breaking down the adhesions, which have often given way with a loud snap, and as soon as tenderness was diminishing, anæsthetics have been administered and passive motion resorted to, but after leaving a hospital some of these cases have been seen, and it has been found that the patient has not continued either active or passive motion and the joint has become fixed, though in a far better position. A few brief directions for the conduct of this method in the principal joints will be of service :—

Shoulder.—The palm of one hand should be placed over the affected shoulder, grasping the humeral head in front and behind, the other should grasp the elbow in a flexed position, and the humerus should be rotated out and in, then it should be moved antero-posteriorly, and subse-

quently adducted and abducted, afterwards circumducted, at first with the limb near the thorax, and subsequently gradually raising it. Great care must be taken not to attempt abduction before the adhesions have been freely separated, lest downward or forward dislocation be produced, or mischievous laceration of the soft parts on the inner side of the joint result.

Elbow.—One hand should grasp the fore-arm firmly above the wrist, and the palm of the other should rest on the olecranon with the fingers encircling the joint, and the thumb resting on the head of the radius. First flexion and then extension, the former in short, sharp jerks, should be employed. Then movements of pronation and supination should be adopted, followed, if necessary, by division of the biceps tendon—which must be done from the inner side, away from the brachial artery—and only if extension cause it to stand well out, away from the blood vessels. Care must be taken not to commence by extension, lest the radius be displaced forwards.

Wrist and Fingers.—Each finger should be grasped between the fingers of one hand, while the thumb and two first fingers of the other, flex and extend, first the ungual, then the middle, and subsequently the proximal phalanges. Flexion is the first movement, and should be done quickly, and after each finger has thus been treated they should all be grasped and served similiarly. The metacarpo-phalangeal joint should be flexed; extended, and circumducted. In wrist disease the fingers are often fixed by teno-synovitis, and must first be dealt with. To free the *wrist*, the lower end of the fore-arm should be grasped in one hand, and the carpus and metacarpus in the other. Flexion is the first movement, then extension followed by rotation. Rapid, short jerks are most effectual in breaking down adhesions of these parts, and passive motion must subsequently be

daily adopted to prevent refixation of the joint. Luxation of the carpal bones is, even in these cases, a rare occurrence.

Ankle.—In cases of rectangular anchylosis, if it be desired to make attempts to restore motion, much force should not be used in breaking down adhesions, for the mobility of the tarsal joints largely compensates fixity of the ankle. This latter may be ascertained by pressing the thumb or finger firmly between the tibialis anticus and tip of the internal malleolus, and by flexing and extending the foot with the other hand. If the astragaloid head and neck do not move, then it may be concluded that the ankle joint is fixed. If the foot be anchylosed in extension, the heel should be grasped with one hand and the anterior part of the foot with the other, and sudden jerks in the direction of dorsal flexion should first be adopted. If the tendon-Achillis resist it should be divided. In some cases it may be necessary to adapt a casing to the foot, to which a handle affording leverage is attached, and even great force may fail, as the astragalo-scaphoid and calcaneo-cuboid joints are very movable, and thus diminish much of the force intended for the ankle. If there have been much peri-articular inflammation, graduated extension must be adopted, for fear of tearing the tibial vessels, and force should be carefully regulated for fear of spraining some of the tarsal articulations. If these attempts at reduction have failed, the question of partial excision, or of breaking down the adhesions, after opening the joint, will have to be considered. I prefer the latter proceeding, because the joint can readily be reached by a single longitudinal anterior incision without damage to vessels, nerves, or tendons, and fibrous bands may be loosened, and the foot fixed at a right angle.

Knee.—The process will vary according to whether the

knee be fixed in a straight or bent position, the latter being much commoner. In these cases the deformity may be reduced by allowing the leg to project beyond the operating table or bed, and by fixing or setting the thigh against the latter; then, grasping the leg near the ankle, using it as a lever, and applying short, sharp jerks until a cracking sound be heard. If the *gradual* or *repeated* method be adopted, proceedings must now cease; but I commonly proceed to complete flexion, and then to as much extension as can be gained, adopting short, sharp manipulations. Care should be taken to place the fingers on the tibial tuberosities, so as to note that they follow normally when extension is attempted, and that neither lateral motion, nor rotation of the leg or thigh, is produced. Another plan that I have found serviceable is for the surgeon to grasp and steady the lower part of the thigh between his thorax and arm, while the fore-arm and hand encircles the knee, his free hand grasping the leg, and proceeding as before. Tense tendinous and fascial structures have to be divided, and this should be done from the outer and inner side, instead of from the popliteal space, as these punctures may become rents in attempts at extension. It is less difficult to act upon a knee fixed in extension. The back of the patient's thigh may rest upon the surgeon's knee while he grasps the lower part of the leg, adopting successive sharp jerks; or the leg may be steadied or fixed to the bed or operating table, and pressure may be applied by the hands to the leg from before backwards.

In attempts at correcting the deformity, if the adhesions be firmest at the back of the joint, the anterior part of the tibial head will often be impacted by cancellous fracture of the femoral condyles, and if the union be strongest in front of the joint, luxation backwards is the usual result; but I have found that tenotomy of the hamstrings, either before or after the forcible rupture of adhesions, combined with

extension, will considerably assist in bringing the limb into a good position.

In cases where the patella is fixed to the femoral condyles attempts at reduction may end in dislocation back, or back and out, or to rupture of the fattily degenerated quadriceps above the patella. This latter is indicated by a hollowness above the patella as the leg is being straightened, and further attempts should be desisted from. A back splint with foot-piece should then be applied, with a firm pad at the calf, and pressure should be applied to the thigh directly

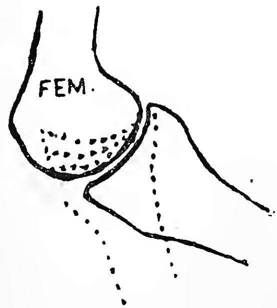


FIG. 200.—Diagram of infraction of tibia into cancellous tissue of femoral condyles in attempted reduction, when the anchylosis is strongest posteriorly.

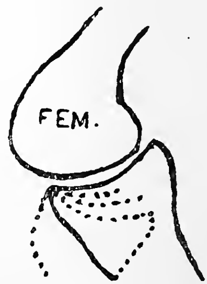
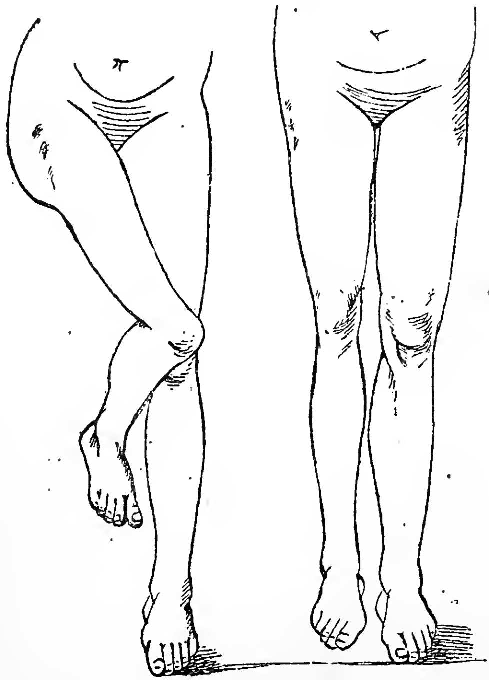


FIG. 201.—Diagram of subluxation in attempted reduction when the anchylosis is strongest anteriorly.

backwards at the lower-third of the femur. If necessary, in ten days to a fortnight further attempts may be made, and may prove successful. If firm fibrous adhesions connect the patella to the condyle these may be subcutaneously severed by the use of a strong tenotome. One puncture should be at the inner and lower edge of the patella, and the other at the upper and outer, and the instrument should freely separate adhesions in all directions, the leg should then be well worked and the patella subsequently grasped, and freely moved about. Some surgeons, however, prefer to separate patellar adhesions before acting on the leg. An

ice-bag should be subsequently applied to the limb over a firm flannel bandage. This operation is recommended by Celsus,* and has been reintroduced by Mr. Maunder in two cases at the London Hospital.† I have once adopted it, but prefer *brisement*, either gradual or entire.

Hip.—The patient being in the supine position, the pelvis



FIGS. 202 and 203.—Bony anchylosis of hip and contraction of knee in a young man of twenty-three, before and after operation. Cervical osteotomy at hip and tenotomy of hamstrings. The knee was first corrected and then the hip.

should be firmly steadied with a broad strong leather strap fixed to the operating table. The tuber ischii should be close to the table's edge. The surgeon, grasping the thigh just above the knee, should apply successive sharp jerks

* Book 7, c. 4, sec. 2.

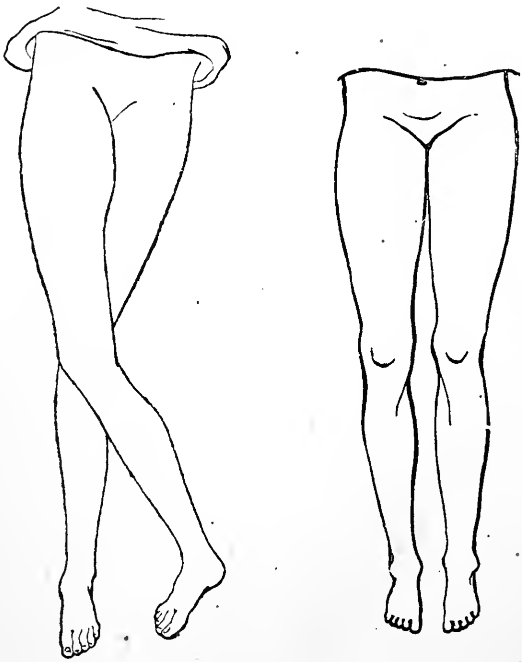
† *British Medical Journal*, 1875, Vol. 2, p. 586, etc.

in the direction of flexion, aiding this movement with his body-weight, by pressing with his thorax on the bent knee. When flexion has been sufficiently accomplished, extension must be adopted with quick, short jerks. This should be followed by abduction, and if the abductors resist they must be divided. Circumduction should next be adopted, and, if necessary, the patient placed on a mattress on the floor. These proceedings must be adopted with caution, judgment, and experience, because fracture of the femoral neck may result, as in a case recorded by Tillaux. But this accident is not of itself to be feared, as good position and a useful limb have resulted, so that some surgeons look upon it as desirable, if it can be effected without injury to important neighbouring parts.

Tenotomy.—Tense tendons and fascia on the outer and inner side of the joint may need division, the adductors and gracilis may be divided by a puncture passing between them and the femoral vessels, and the cutting edge of the knife being turned towards the skin, a sawing motion of the tenotome, with pressure of two fingers of the opposite hand on either side of the blade, will effect the division. The tensor fascia femoris and fascia lata may be divided through one puncture a little below, and internal to the anterior superior iliac spine; the cutting edge is then turned outwards, and a sawing movement adopted until these structures are felt to be freely divided. The rectus femoris may be divided by a puncture at its outer edge, about half an inch below the anterior inferior spine of the ilium; the blade must pass deeply and go well behind the origin of the tendon. The cutting edge must then be turned towards the skin, the handle depressed, and a sawing motion wlll complete the division.

In *bony* anchylosis, and in the firmest kinds of fibrous union, either *arthoclasy*, *osteoclasy*, *osteotomy*, or *excision*

may have to be selected, and some of these proceedings vary according to the joint affected. In the *shoulder*, excision of the head of the humerus appears to be the best operation, as it usually gives good subsequent mobility, but if mere rectification of position without motion be desired, linear osteotomy will suffice. In the *elbow*, excision is the best plan, and partial excision



FIGS. 204 and 205.—Cross or X-shaped anchylosis in a girl of fifteen after morbus coxæ of right side, which was osteotomized, and on the left side the fibrous anchylosis was broken down.

is preferred by Watson, and Annandale of Edinburgh. I have removed the articular surface of the humerus in three such cases with very satisfactory results. In osseous anchylosis of the *wrist*, excision, either partial or complete, may be performed, but if the fingers be fairly movable no operative treatment is necessary.

In the *ankle*, bony anchylosis at a right angle is best left to itself, but partial or complete excision may be adopted in other vicious positions of the joint. Many plans have been devised and adopted in osseous anchylosis of the hip and knee, and I will now consider them:—

At the *hip*, the earlier operations were by large open wound, but Brodhurst and Adams operated some years ago by much smaller incisions. The section of bone was formerly effected by means of a small saw introduced through an opening sufficiently large to admit it. In the accompany-

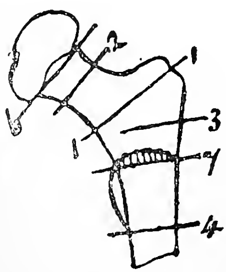


FIG. 206.—Diagrams of osteotomy lines for hip anchylosis: 1, Rhea Barton's; 2, W. Adams's; 3, My incomplete infra-trochanteric; 4, Gant's; 6, Volkmann's; 7, Sayre's.

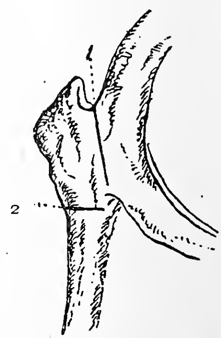
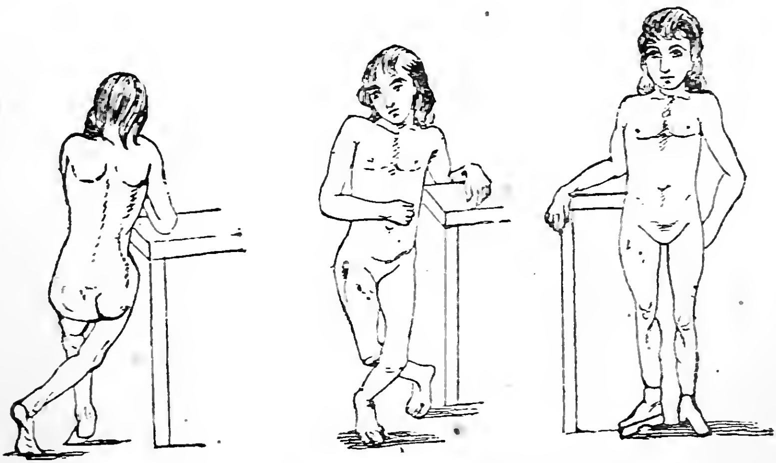


FIG. 207.—1, Osteotomy line, in fusion of both bones; 2, The plan which I have oftenest adopted.

ing diagram, No. 2 shows the line of Adams's operation; but it must be borne in mind that in old cases the greater part of the neck of the femur has become welded to the innominate bone, so that Fig. 207 more accurately represents the condition of parts and the line which the chisel should take.* The steps of osteotomy are so well known now-a-days, and are sufficiently described in the chapter on Genu Valgum, that I need not now occupy

* Mr. Keetley has published an excellent paper on Osteotomy in the *British Medical Journal* for this year.

space by going into the details. Here, as in knock-knee or bowed legs, the osteotomy may be complete or partial, its object being to correct deformity and to lengthen the limb, and not, as Sayre attempted, to establish a false joint, which, though not impossible, leads to a weak limb. Line 7 Fig. 206 shows the situation of Sayre's operation for a new joint, and the shade indicates the hollowing out of the upper end of the bone and the portion of bone removed. Line 1 shows Rhea Barton's operation, and this was the

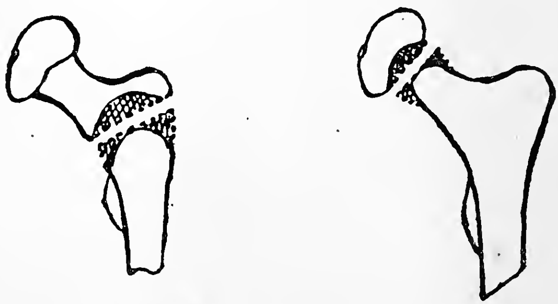


FIGS. 208, 209 and 210.—Bony anchylosis of right hip and contracted knees in a girl aged eleven. Posterior and anterior views before operation. The figure on the right shews the deformity corrected.

first recorded for bony anchylosis of the hip. Line 4 shows Gant's *infra-trochanteric* operation, and line 3 shows the incomplete osteotomy usually adopted by me. All I need further say is that I do not operate under the spray, and that I close the wound with a pad of oiled lint, over which is put a flannel roller or cotton-wool, and I use either a plaister of Paris spica bandage, keeping the leg extended by weight and pulley, or attach the limb to a long splint with extension arrangements. Volkmann has

advised two plans for the formation of an artificial joint. The first operation consists in making a new joint between the trochanters, and the second attempts this just below the femoral head. The bone is divided along Rhea Barton's line; the lower fragment is then rounded off, and the upper excavated. The second operation resembles the first, but its position is higher up.

In angular osseous anchylosis of the *knee* the operation formerly adopted was excision of more or less of the anchylosed parts. Number 1 in Fig. 213 shows Rhea Barton's wedge-shaped excision of the femur. Number 2 shows



Figs. 211 and 212.—Diagrams of Volkmann's operations for the formation of a new joint near the hip.

Gordon Buck's; 3 is Eantrikin's; 4 Langenbeck's. Gross, of Philadelphia, and Mr. Stromeyer Little, formerly of the London Hospital, have also successfully performed subcutaneous osteotomy, separating the femur from the tibia. Barwell divides the operation into two stages, dividing the femur above the joint in one stage, and the tibia and fibula below it at a later. If there be femoro-patellar bony anchylosis and fibrous anchylosis in the remaining part of the articulation, the latter may be separated subcutaneously, as before described, or by means of a small chisel, before the remaining adhesions are attempted to be

broken up. In these cases, after flexure of the limb, the joint should be well surrounded with cotton-wool, and evenly and pretty firmly bandaged, and a rubber bandage, judiciously applied, is of great advantage in preventing inflammatory effusion. An ice-bag may be applied for two or three days if necessary. Patellar and other strong fibrous intra-articular adhesions have also been separated by open wound. There is a good deal of bleeding in these cases, and in the few cases which I have seen operated on by this plan, anchylosis returned after a prolonged convalescence.

In many cases of anchylosis, as well as in the numerous osteotomies I have had occasion to perform chiefly in the lower limbs, I have had the good fortune never to lose life, joint, nor limb, but always to considerably improve position, giving *often* lengthened, and *always* serviceable, limbs.

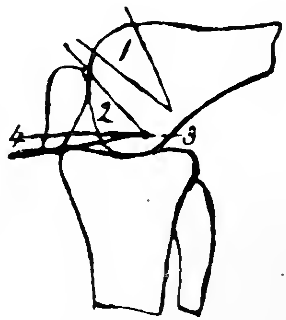
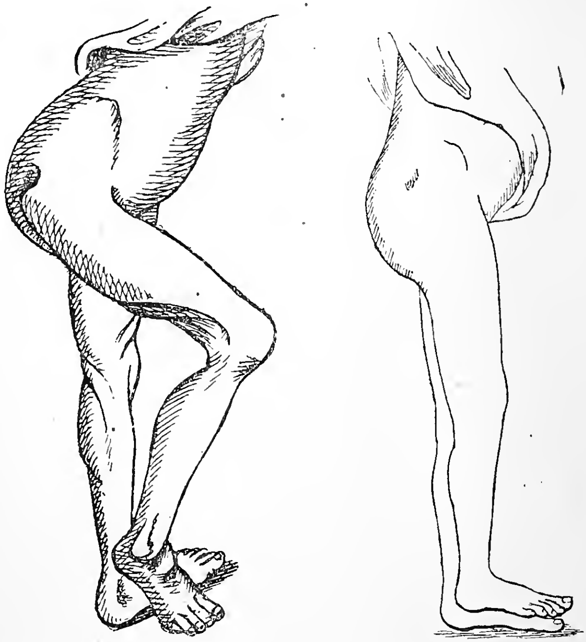


FIG. 213.—Diagram of operations for angular anchylosis of knee. 1, Rhea Barton's cuneiform osteectomy; 2, Gordon Buck's, including patella, and Eantrikin's horizontal cut passes to 3. 4—3, Line of incision for subcutaneous osteotomy of Langenbeck and Gross.

Osteoclasy and *arthroclasy*, as described in the section on genu valgum, may also be applied in cases of anchylosis, and especially at the knee. French surgeons are accumulating a good experience with these methods, but so far the proceedings have not been at all, or scarcely at all, adopted in this country. It seems to me, in proper cases, a very suitable operation.

Anchylosis of the Jaw.—This is almost always false, and its causes, are in general, those which produce anchylosis in other joints, but certain regional affections are prone to fix the temporo-maxillary articulation, such as

inflammatory affections of the teeth and alveoli, suppuration of the middle ear, severe stomatitis, salivation from mercury, inflammation about the parotid glands, &c. Mr. Hilton* relates a case of *true* or *osseous* anchylosis accompanying disease of the cervical vertebræ; and cicatrices of burns of the mucous membrane, or those due to stomatitis, cancrum



FIGS. 214 and 215—Bony anchylosis of hip in a man aged fifty-four, before and after operation.

oris, &c., also lead to *false anchylosis* through abolishing the normal elasticity of the mucous membrane of the cheek, which is converted into a fibrous material. Muscular contraction, which is generally secondary to inflammatory mischief of the teeth, jaws, or neighbouring soft parts, may also cause closure of the jaws.

* "Lectures on Rest and Pain," Third Edition, 1880.

Treatment.—This varies according to whether the anchylosis be fibrous or bony. In the former, gradual dilatation by wedges acted on by screws placed between the molars on the affected side, will often afford permanent relief, but the procedure may be rapidly done under anæsthesia, and when the adhesions are well broken down subsequent passive and voluntary motion should be resorted to. In this proceeding care should be taken not to produce dislocation. Subsequent inflammation of the joint is rare. When the anchylosis is due to contracted cicatrices, these may be carefully divided, either partially in several places, or completely, in one or more, and stretched, and the jaw should be kept open during the process of healing; and it must further be borne in mind that the new cicatricial tissue is very apt to contract and reproduce the deformity, so that, where possible, grafts should be implanted, as the tissue resulting therefrom is less contractile. Operations upon cicatrices within the mouth can only be performed if the cheek structures are not affected by the cicatricial contraction. If these means fail, or be thought inadvisable, the lower jaw may be divided at some suitable spot, and a false joint formed. Esmarch's plan consists in removing a small piece of bone in front of the cicatrix, and forming a false joint. Rizzoli simply divides the jaw. In the latter case, unless constant motion between the parts be kept up, reunion is apt to occur. The former operation is best suited to cases of unilateral anchylosis. Muscular anchylosis is oftenest due to contraction of the masseter, in which case it may have to be divided.

Bony anchylosis is fortunately rare. In such cases the ascending ramus will have to be divided high up, close to the joint; or the condyle, or its remains, will have to be excised, a proceeding of some difficulty, requiring correct anatomical knowledge and operative skill.

Anchylosis of the Joints of the Hand and Foot.—In the *hand*, unless the position be such as to interfere with the occupation of the patient, the parts are better left alone, except in cases of fibrous anchylosis, which are generally readily amenable to treatment. In bony anchylosis excision has, in some cases, proved useful in my hands, but for working people amputation is the best resource, as time with them is of great moment, and one cannot certainly promise a strong and useful limb after excision. In the *foot*, if the tarsal joints be anchylosed and any great inconvenience be complained of, the foot should be examined under anæsthesia, and fibrous adhesions may be broken down and kept separated by subsequent passive motions; but if these methods fail, partial or complete excision may have to be adopted, especially if great pain and inconvenience be complained of. In fibrous anchylosis of the phalangeal joints *brisement forcé* may be of service, but if the adhesions be very firm or bony, amputation must be performed. I have excised the metatarso-phalangeal joint of the great toe three times, once for disease of the joint subsequent to inflamed bunion, once for anchylosis, and once for rheumatic arthritis with pain and lameness, and a serviceable foot resulted in each case.

Unreduced Dislocations.

Such cases are not infrequently seen by orthopædic surgeons, therefore a brief account of the proper method of dealing with them will be appropriate. Those desiring to enter further into the pathology of this subject must consult special works on dislocations.

Treatment.—This will depend upon the age of the patient, the history, nature, and subsequent complications of the case, and on the extent of the changes which have

arisen subsequent to its occurrence. Old dislocations have been reduced many years after the accident, and, on the other hand, some recent ones have been unable to be reduced, and this in the ball-and-socket joints has been due to reunion of the rent in the capsule. The condition of the parts can only be satisfactorily made out under anæsthesia, when careful attempts should be made to break down all adhesions. If the misplaced bone is found to move sufficiently freely, methodical attempts at reduction, according to the directions to be found in general works on surgery, must be made, and when this is effected the limb should be kept quiet for a few days with an ice-bag applied over the joint. Passive motion with gentle frictions and massage should then be commenced and gradually increased, care being taken not to give much pain.

Where muscles, tendons, or fascial bands are tense and offer opposition to reduction they must be tenotomized, and this should be done about three days before attempts at reduction are adopted, so as to allow the punctures to heal. The hip if reduced will be much more useful than the shoulder, which, though much more easily reducible, does not, as a rule, return to its normal functions nearly so rapidly. When repeated attempts at reduction have failed, the propriety of excision will have to be considered, or an attempt may be made to divide the adhesions by open wound or subcutaneously. It may be advisable in some cases to try and form a new joint just below the humoral head in old shoulder dislocations. Mr. W. Adams has recently advocated at the Medico-Chirurgical Society, excision of the femoral head in old unreducible dislocations at the hip, following Mr. Rawdon.

Complications.—Large vessels and nerves have been torn in the attempt to reduce old dislocations of the shoulder and knee. This is partly due to their being

involved in the inflammatory mischief resulting from the accident, and partly to their contracted state; but it may occur in old people through atheroma of the vessels. Several instances of accident have been recorded. I have seen two cases which were admitted into the London Hospital. In both there was rupture of the axillary vessels prior to admission, and both were for a short time under my care. One case has been published by my colleague, Mr. Rivington. A French surgeon once had the misfortune to pull off the arm from an aged person at attempts to reduce an old dislocation of the shoulder; and Mr. Thomas Smith has recorded a somewhat similar case occurring in his practice at Bartholomew's Hospital, in the reports of that institution published some years ago.

CHAPTER XXV.

NERVOUS DEFORMITIES AND MUSCULAR CONTRACTIONS.

In previous sections contractions and relaxations, due to muscular or nervous irritation, or loss of power, have been described. In the chapter on the spine mention has been made of paralytic scoliosis, and I need here only advert to those deformities, usually temporary, produced by nerve irritation and muscular spasm, such as opisthotonos and pleurosthotonos; but I should mention that there are some rare cases in which spinal deformity is produced by tonic contraction, and subsequent retraction, of the spinal muscles. In these cases—and the majority of the few I have seen have been in children—the deformity results subsequent to tetanic contractions which have become permanent in certain groups of muscles. A good account of this class of case will be found in the recent edition of Rilliet and Bartez.*

The *treatment* of such cases consists in removing any known source of irritation, the use of massage, electricity, and gymnastics to the affected muscles, and the judicious use of properly constructed apparatus.

In the sections devoted to the upper and lower limb, the various tonic and paralytic deformities have been described; but it now remains to give a succinct account of certain

* "Traité Clinique et Pratique des Maladies de l'Enfance," 1884.

paralytic deformities affecting the trunk and certain groups of muscles of the limbs, which are commonly met with in orthopædic practice. It must be borne in mind that the surgeon, generally, sees these cases when the muscles are atrophied and a paralytic deformity produced; but, occasionally, he gets them in a more hopeful stage, and is able to do much for the reconstruction of the limb functions. Paralytic deformities may be due to various lesions of the nerve centres, which will be found described in modern text-books on nerve diseases; but I may say that the various paralyses of the limbs, when occurring in children, are roughly classed by the surgeon as cases of infantile paralysis, though it would be more correct to call them cases of paralysis in infants and children. The practical point to bear in mind is, that no operative treatment for correction of deformity should be undertaken in the inflammatory or irritative stages of the disease; but there is little fear of this in ordinary orthopædic practice, for cases do not usually come when in that stage.

Infantile Spinal Paralysis.

Symptoms.—I need only refer to those symptoms which are observable when the case usually presents itself for treatment to the surgeon. It will then be found that the paralysis varies in extent and severity; it may affect all the limbs or only one, the lower being the most frequently damaged, and even these it may affect unequally, the leg muscles being commonly affected, while sometimes the muscles of the thigh, and even those passing from the pelvis to the femur, may be involved. There may be hemiplegia or cross-paralysis, one upper limb and the opposite lower limb being affected, or only a group, or even a single muscle, may be affected. The temperature of the

affected part is commonly 5° below that of the opposite side, but sensibility is not usually much lessened, though reflex excitability is diminished and sometimes abolished.

To test the state of the muscles galvanism and faradization must be employed; the former, even in low tension, will produce movements, before the atrophic stage, in the most paralyzed muscles, while faradization almost always fails to produce any contraction in them. This reactive condition is present in the first stage, which varies from a month to six weeks before the second or atrophic stage commences. At this period some, or even the whole of the paralysis may disappear; but when this is not the case atrophy rapidly progresses, and the skin is of a red or purplish hue, the circulation of the limb is very torpid, as is evidenced by pressure of the finger, when a white patch appears and does not regain its colour for some time. I have noticed in several paralyzed legs that a broadish collar of subcutaneous fat is present about two or three inches above the malleoli. In this condition muscular electric contractility disappears, so that the strongest induced currents, and, in some cases, even powerful primary currents, fail to induce the slightest contraction; and as a point of diagnosis it should be mentioned that in no other disease is the electric excitability so thoroughly abolished.

This muscular atrophy, accompanied with relaxation of the ligaments, leads to altered positions of the bones entering into the joints, so that in old cases of paralysis of the upper limb the humerus falls away for an inch or more from the glenoid cavity, and the passive motion of the joint is much increased, and the latter may even be dislocated. The elbow, in such cases, can readily be hyperextended so as to form a bulge anteriorly, and the fingers, in cases of partly recovered paralysis of the flexors, can be put by the patient in a state of extreme extension, so as to have a dorsal

concavity. When contraction and retraction occur we may have *club-* or *griffin-hand*, the fore-arm being firmly flexed upon the arm, and the latter drawn tightly to or partly across the chest. The bones become atrophied and arrested in growth, and therefore the limb is shorter than its fellow, and in estimating such cases, measurement should be taken after the head of the bone is brought in contact with the glenoid cavity, otherwise its weight will cause the separation already referred to, and will lead to error. Osseous change is not always present, and when so, indicates extensive central lesion.

In the lower limb, the muscles commonly affected are the tibialis anticus and extensors of the toes, the peronei, the quadriceps, and the glutei. In the upper limb, the deltoid appears to be most commonly attacked. The method of progression will vary according to whether one or both limbs be affected. If only one, the patient will walk with a crutch under the arm of the affected side, and if the diseased limb be used at all it will only be in conjunction with the crutch, which acts as an artificial leg. The patient, standing on the sound limb, projects the crutch with the dorsum of the foot touching the shaft of the instrument, and resting the leg and body on the crutch, the sound limb is brought forwards, and by the alternation of these motions progression is secured. When both limbs are affected the trunk is slightly inclined forwards and the head backwards. There is great lordosis, the pelvis being carried up and backwards. The thighs are semi-flexed and adducted, the knees semi-flexed and in a valgoid condition. The feet are extended partly by their weight, and partly by the contraction of the tendo-Achillis, and scrape the ground during walking. In standing, equilibrium is maintained by widely spreading the feet; but in walking with crutches these patients generally swing one or both

limbs forwards, like a pendulum, as there is no power of extension. If only one limb be thrown forward the patient, when he feels it to have firm support, throws the other limb forwards in a corresponding manner; in such cases examination will show that the glutei are wasted and the gluteal fold flattened. The thigh muscles may be a little affected, the extensors of the foot are considerably wasted, the flexors are somewhat less so. Commonly, though the triceps is nearly normal, the adductors and sartorius are contracted or retracted. In such cases the pathological condition appears to be a disseminated sclerosis.

In other cases the parents tell you that the child tumbles about, that it can't lift its feet and drags them upon the ground, and a slight obstacle upsets it. In such cases examination shows that the gluteal and femoral muscles are normal, and that the knees are not at all, or scarcely at all, in a valgoid condition, while the leg muscles are much wasted. The calf is flat, and there is a groove where the extensors should be; the ankle joint is very loose, allowing of considerable motion; and the walk is characteristic, for the child throws the whole limb forwards while the other foot touches the ground. If the child be examined on a sofa with the legs extended, it will be found that on being told to raise the toes it can do so but very slightly, and even this will be prevented by gentle pressure with the finger on one of the toes. If the foot be placed in semi-extension and the child told to flex it, it will easily accomplish this at starting, but at a certain point it stops and can't bring the foot to a right angle, and this condition if allowed to continue will result in paralytic equinus, because of the weight of the foot and the greater power of its extensors. The skin in such cases is subject to ulcerations, and especially to pressure sores. There is another class of

cases in which patients apply for treatment after injuries about the knee or to the patella, and it will be found that the quadriceps is considerably wasted, but this atrophy is the result of prolonged rest of the muscle occasioned through the injury, and also through the continued approximation of its points of attachment.

Treatment.—When the muscles are contracted or retracted tenotomy is called for, care being taken not to attempt to correct the deformity too rapidly, and also to avoid pressure and sores. But in these cases, after the deformity is corrected and an appropriate instrument applied, frictions, massage, electricity and instructing the patient, if old enough, to exercise frequent voluntary motion, must for a long time be resorted to.

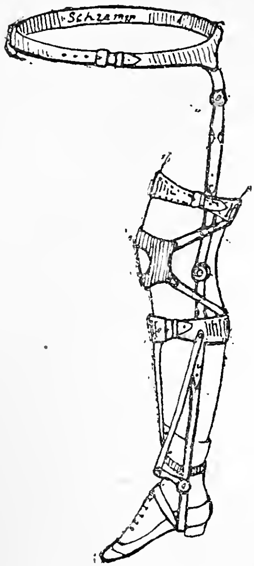


FIG. 216.—Instrument for paralysis of lower limb, with elastic action for equinus.

PARALYTIC DEFORMITIES OF THE UPPER LIMB.

Paralysis of the Deltoid.—The shoulder is much flattened and angular, and in pressing firmly over the head of the humerus the glenoid cavity can be felt and the projecting acromium is very apparent above it; and in some cases, if the arm be slightly drawn downwards, the finger can be passed between the head of the bone and the glenoid cavity, so that not only is there wasting of the deltoid, but also considerable relaxation of the ligaments. This affection may be due to spinal paralysis or to injury of

the circumflex nerve, and it must be treated by frictions, shampooing the muscle, and the various forms of galvanism and electricity.

Paralysis of the Serratus Magnus.—This muscle alone, or with it the rhomboids and trapezius, is not very infrequently found paralyzed. The *symptoms* vary according to the position assumed by the affected side; the disease may, however, be bi-lateral. When the arm is pendant the scapula of the affected side is raised and is nearer to the

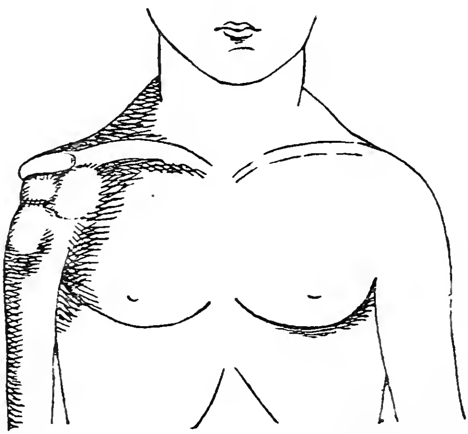


FIG. 217.—Paralysis of right upper limb, showing the characteristic deformity at the shoulder and the wasting of the arm.

spine. The inferior scapular angle is higher and rotated inwards through the weight of the arm and the action of the rhomboids which raise and fix the inferior angle. The posterior border is more obliquely placed than natural through rotation of the scapula, and there is increased breadth of the affected side just above the posterior axillary fold. In some cases the affected shoulder is lower than the opposite one.

If the arm be raised horizontally up and out in a line with the body, the scapula is shot backwards and forms a

prominence in the dorsal region. When the arms are horizontal the scapula passes up and backwards without rotation. This is due to the action of the trapezius and levator anguli scapulæ unopposed by the serratus. If the arms be brought horizontally forwards so as to make the palms touch, the dorsal scapular muscles, following the humerus, drag the scapula outwards, and its venter is exposed and can readily be explored, but if the serratus were acting the shoulder blade would be kept applied to the thorax. In this movement it will be found that the

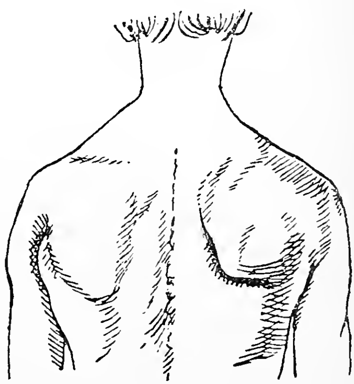


FIG. 218.—Paralysis of right serratus magnus.

hand of the affected side falls a good deal short of the other, so that the *length and power of reach* are much diminished. If the arm be carried horizontally backwards the scapula overlaps the spine. This is due to the action of the trapezius and latissimus dorsi. In these movements the digital serrations of the muscle are visible in moderately thin people on the sound but not on the affected side. In raising the arms in an extended position upwards and forwards, and keeping them in that position, it will be found that the trunk inclines to the left, and that this movement cannot be fully accomplished without flexing the fore-arm

on the arm. The humerus will also be much abducted. In this movement the normal scapular rotation on the ribs cannot be effected unless the serratus act and give stability for this pivot-like action. The scapula becomes very prominent and recedes instead of advancing; it is also higher, and its prominence is so great that any part of its whole thickness can be taken between the fingers. Sometimes the bone is so raised that its upper border can be seen from the front. The *cyrtometer* shows that considerable difference exists between the two sides of the chest during respiration, if the arms be raised.* The patient rarely complains of pain, except perhaps at the onset of the disease, but finds the shoulder weak, and that there is pain and inconvenience in raising it or in pushing anything.

Causes.—It may be due to cold, infantile or other paralysis, or may follow typhoid fever, as in the cases of Clutton,† Baümler,‡ and those of others which have been recorded. I have seen it following, and apparently due to injury and also as a result of infantile paralysis, and in other cases without obvious cause. It may also result from progressive muscular atrophy.

Diagnosis.—The altered position of the scapula may at first sight lead to the supposition of lateral curvature, but the examination of the spinous processes, showing them to be in the right line, and the fact that there is no rotation and consequent bulging of the ribs on the affected side, will guard us against this source of difficulty. In the rarer cases in which there is congenital deficiency of muscles, the diagnosis can only be correctly ascertained after getting an accurate history of the case.

* Vivian Poore, *Trans. Clin. Soc.*, Vol. 8, p. 83.

† *St. Thomas's Hospital Reports*, New Series, Vol. 12, p. 176.

‡ *Deutsches Archiv für Klin. Med.*, 1880, B. 25, p. 304.

Treatment.—Galvanism two or three times a week by means of the induced current is of great service. The positive pole should be placed over the spine on a level with the upper border of the scapula, and the negative, successively, over the digitations of the muscle. The current should first be strong and gradually diminished in intensity. Frictions and massage, together with passive motions, should also be resorted to. The *prognosis* is generally favourable.*

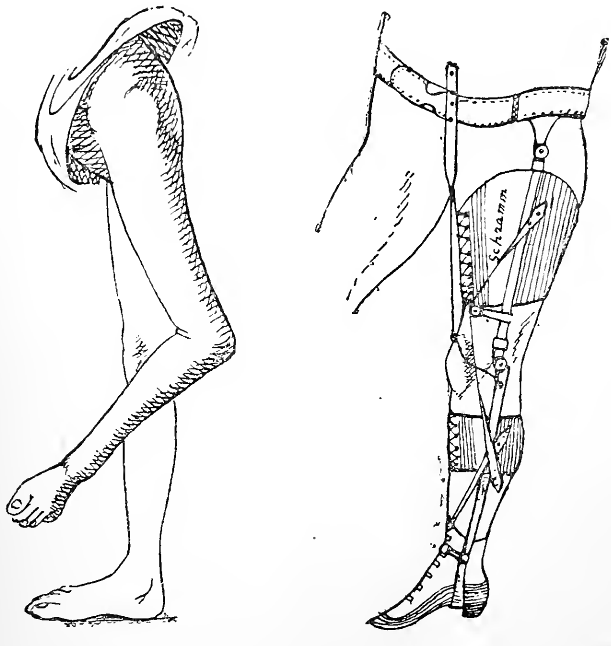
Paralytic Displacements and Dislocations of the Lower Limb.

In cases where paralysis has existed for any time, or has progressed rapidly, the resulting laxity of the muscles and relaxation of the ligaments allows an abnormal degree of motion in the larger joints; such as those of the ankle, knee, and hip. The various forms of paralytic club-foot have already been described, and the paralytic form of genu valgum has been alluded to in the chapter on that subject, but there are other deformities and displacements at the knee due to paralysis; for instance, the condition of hyperextension at the knee, in which there is an angle at the popliteal space instead of forwards during standing, is not very uncommon in my experience. Paralytic genu varum may also be met with, and in some cases the joint is so lax that a considerable amount of rotation of the leg at the knee is permissible. It is, however, only of late years that paralytic dislocation of the hip has been described, though all surgeons of large experience must have seen such cases, and orthopædists and neurologists

* See papers by Dr. Ferrier, *Lancet*, 1883, p. 998, and by J. Dixon Mann, *Lancet*, 1884, February 2nd and 9th.

must be familiar with the very lax and weak condition of paralyzed hip joints.

Verneuil first drew attention to the fact that some of the cases of so-called congenital dislocation of the hip appearing or becoming evident sometime after birth, were either not really congenital displacements, or were due to the con-



FIGS. 219 and 220.—Paralytic backward dislocation of knee, and instrument for the same.

genital form (borrowing a term from the pathology of hernia) of the malady. He states that in these cases there is atrophy of the glutei- and pelvi-trochanteric muscles, and that this is probably due to unobserved infantile paralysis. In these cases the inactivity of the adductors whose action is unopposed through atrophy of the glutei, leads to dorsal dislocation, but in some instances the glutei- and

pelvi-trochanteric muscles are intact, while the psoas and adductors are paralyzed. These cases are rare, and lead to supra-pubic dislocation. When all the muscles of the thigh and hip are paralyzed, there is exaggerated motion at the joint but no displacement. The chief cause of these dislocations is, undoubtedly, the muscular action of the antagonists to the paralyzed muscles, though the weight of the body in walking further distends the already lax capsular ligament and assists in the luxation process. Infantile paralysis, adult spinal paralysis, and progressive muscular atrophy, all lead to the production of this deformity. I have observed and shown a few cases of paralytic coxal dislocation to my class, and hope to draw the attention of orthopædic surgeons and neurologists to these observations in a separate paper. The annexed figures illustrate one of these cases and the instrument worn for its relief.

The *deformities of the hand* due to nerve lesions will be found in the chapter on hand distortions.

Muscular Contractions.

The *contractions* due to club-hand and foot are familiar examples of this class of affections, but the orthopædic surgeon frequently has to treat cases in which the muscles of the limbs, and especially of the lower limb, are in a contracted condition. In such *spastic* cases the knees may be flexed by the hamstrings, or the thighs approximated by the adductors, or flexed upon the pelvis, and it is a somewhat common occurrence to find both these conditions associated with equinus. In the upper limb contractions are rarer, though in cases of hemiplegia, whether juvenile or senile, one is not infrequently consulted about them. In these cases the first stage of the deformity as regards the

hand appears to be contraction on the ulnar side, so that the hand is adducted. This position is favoured by the weight of the hand when the limb is held in its usual position with the radius uppermost. The fingers subsequently become much flexed. In a later stage the biceps contracts and flexes the elbow, and sometimes the arm is more or less fixed to the side of the unused, or contracted, pectorals. In some severe or old-standing cases of lateral

FIG. 221.—Spastic contraction of flexors and adductors of thigh and of the hamstrings and calf muscles cured by tenotomy and subsequent treatment.

curvature the latissimus dorsi is found to be very tense when the patient is extended, and this muscle has consequently been divided by Sayre and others.

Causes.—Of these the most common are central nervous affections, injuries, inflammation, reflex spasmodic contraction, and congenital contraction. Hysterical contractions must be carefully differentiated from these. There is a form of contraction due to position, and inflammation

which occurs in the pectorals after amputation of the breast. I have long been in the habit of preventing this by commencing abduction of the arm soon after the operation, the time varying according to the size and condition of the wound. In old cases of contraction the muscles become degenerated into fatty and fibrous tissue. Rheumatism, syphilis, and gout also produce muscular contractions.

Treatment.—In slight cases manipulations, active and passive exercises, and frictions, will generally suffice, but when the muscles are very tense tenotomy is necessary. In the upper limb it may be necessary to divide the biceps for flexed elbow, or the flexor and extensor carpi ulnaris, and even the superficial flexors in cases of contracted hand.

Tenotomy of Flexors of Wrist and Fingers.—The former muscle should be rendered very tense, and divided by passing the knife from within outwards between the tendon and the brachial artery and cutting towards the skin. The flexor carpi ulnaris should be divided just above the wrist, passing the knife vertically between it and the ulnar artery which is on its outer side, then cutting towards the ulnar side. In dividing the flexors great care must be taken of the median nerve if the operation be done subcutaneously, but if it be done by open wound, a vertical incision, about two inches long, down to the deep fascia should be made and the tendons then divided separately, the nerve held aside and the deep flexors subsequently divided, care being taken as the pronator quadriceps is reached so as to avoid wounding the continuation of the anterior interosseous artery. The radial and ulnar vessels must of course be carefully pulled aside. If the hand be kept quiet on a splint, and the patient be fairly healthy, there is no great risk of tenosynovitis, and a good plan is to apply an ice-bag over the bandages for two or three days.

In slight cases of adduction and flexion of the thighs

and knees, extension by mechanical apparatus, combined with passive motions and massage, may prove successful, but it is commonly necessary to divide the adductors and the hamstrings. In neurotic cases the operation should not be undertaken until all evidence of active nerve mischief has subsided.

Tenotomy of Adductors and Hamstrings.—The adductor longus is usually divided about an inch from its origin, the tendon being rendered tense by abducting the limb; the surgeon's left hand feels for the border of the

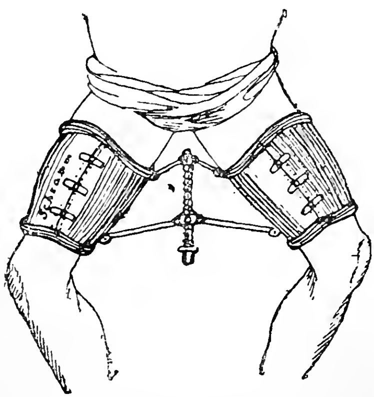


FIG. 222.—Instrument for use after tenotomy of adductors.

tendon, and he then passes the knife on the outer side of the muscle, and well beneath it, cutting upwards and inwards. If, after division of the muscle, other tendons or processes of the fascia lata be felt tense, they should be divided through the same puncture. A dossil of lint is then applied under a bandage, and extension is usually commenced on the third day after the operation.

To divide the hamstrings the patient must be placed on the abdomen and told to flex the leg, while an assistant gently resists so as to bring the muscles into action; their borders are then felt, and the knife passed vertically to the

inner side of the biceps between it and the external popliteal nerve, and the tendon divided outwards. The tenotome is passed to the *outer* side of the inner hamstrings, which are divided in and upwards. They may be tenotomized just above their insertions, or near the upper part of the popliteal space. Care must, of course, be taken so as not to injure the popliteal vessels and nerves. After division of the biceps the external popliteal nerve often stands out, feeling as if a portion of the tendon were undivided, and in severe or old-standing cases it does not readily yield, and may lead the inexperienced surgeon to think that it is a portion of the muscle or fascia, but on no account should it be divided until treatment has shown that this really is a structure other than the nerve. The biceps tendon may also be divided by open incision, and then the external popliteal nerve can be seen and held aside.

In rarer cases other muscles in both extremities may be involved; such as the pronators, the flexor longus pollicis, palmaris longus, and extensors, and may need division. But in the upper limb it is essential always to give a fair trial to manipulations, galvanism, &c., before resorting to tenotomy, as perfect muscular control is of the highest importance in the upper limb; whereas a slight impairment of the lower limb is not a matter of any great moment. The foot may, in a few cases, be in equinus through contraction of the calf muscles, and if mechanical means do not suffice, the tendo-Achillis must be divided. In some other cases there may be calcaneus through contracted extensors, and the tendons of these may need division in front of the ankle. In doing this the tenotome must be directed away from the anterior vessels and nerve.

CHAPTER XXVI.

DEFORMITIES OF THE NOSE AND EAR.

The Nose.—The orthopædic surgeon, dealing as he does with bodily deformities, is sometimes consulted regarding these affections, and as the subject is strictly within the province of orthomorphics, and, moreover, as I have had occasion to successfully treat three cases of deformed nose, one in which the nasal bridge was depressed, one in which these was a congenitally up-turned nose, and one in which there was a deep groove and *nez-rétroussé* following an old depressed fracture of the nasal bones, I wish to call attention to the operation I adopted, as it has been a very serviceable one, surgically and æsthetically.

It is not necessary in this work to enter into deformities produced by new growths, nor is it necessary to speak at length of those very rare cases of congenital double-nose, or bifid nose. Borelli mentions such a case as occurring in a carpenter, but gives no details. It may be that this and similar cases were instances of hypertrophy or congenital tumours, rather than a veritable second nose. Boyer mentions the occurrence of bifid nose, and Verneuil* relates a curious case occurring in the practice of Thomas of Tours, in an otherwise well-developed infant of well-formed parents. This case differed essentially from the

* *Bulletin de la Société de Chirurgie*, 1873.

congenital fissure of the cheek or upper lip, as found in hare-lip. A plastic operation might be serviceable in such cases, and excision or amputation is called for in cases of supposed double-nose.

Deviations of the *cartilaginous septum* are common. If seen when the patients are young, a properly adjusted *nose-machine* may be of great service, care being taken to avoid inflammation and ulceration of the skin. If these means do not succeed excision of a slice of the cartilage on the convex side, or of a V-shaped piece, and suturing the edges, I have known to succeed.

FIG. 223.—Apparatus for straightening deviated nasal septum.

Depression of the nasal bridge is usually not amenable to treatment unless seen at the time, or near to the time of the injury, when the passage of a female catheter into the nostrils, raising the bones and maintaining them in position for a few days by stout rubber tubing, will be of great service, the surgeon's other hand applied over the nasal bridge moulding the comminuted bone over the firm rubber tubing. In one case of depression of the nasal bridge in an otherwise good-looking young man I succeeded by operation in making an artificial bridge, and adopted a similar plan to

correct the unsightly groove above an upturned tip by the following operation. The result of these cases is well illustrated by the accompanying figures taken from a girl aged eleven, operated on a few months since at the London Hospital. In her case a fall had broken and depressed the nasal bridge, and I rendered her nose aquiline by filling up the gap between the bridge and the tip of the nose, but in the case of the young man just alluded to I made an artificial bridge above the nasal bones. As the operation

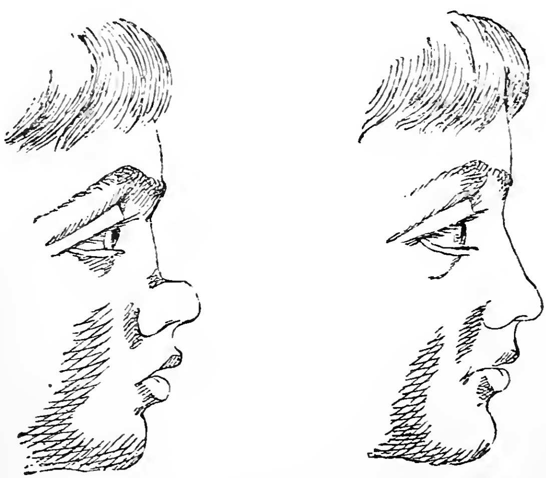


FIG. 224 and 225.—Depressed bridge before and after operation.

is entirely new, a description of it will probably be acceptable.

Operation.—The thumb and fore-finger of the left hand are placed at the sides of the nose, and the soft parts thoroughly raised until they are in the desired position, the nose being viewed in profile. A stout needle carrying a strong silver wire is then passed just above the fingers holding the nose. It is directed obliquely towards the mid-line, then depressed and passed along under the skin

to a corresponding point on the opposite side. About two inches of wire are left protruding on either side of each puncture. The soft parts are again raised, and the needle introduced about an eighth or a quarter of an inch above and below this puncture, but the number of the wires passed must depend upon the amount of the deformity. The ends of the wires are then grasped by both hands, and the wires bent and raised up in a curve so as to assume the desired shape. The ends are cut off, leaving a quarter of an inch projecting, and these are protected by oiled-lint. The immediate result is most satisfactory, and is due not only to the shape given to the wires but to blood-clot forming around them. This subsequently becomes organized, and forms a prominent bridge around the wires, which must be left permanently in place.

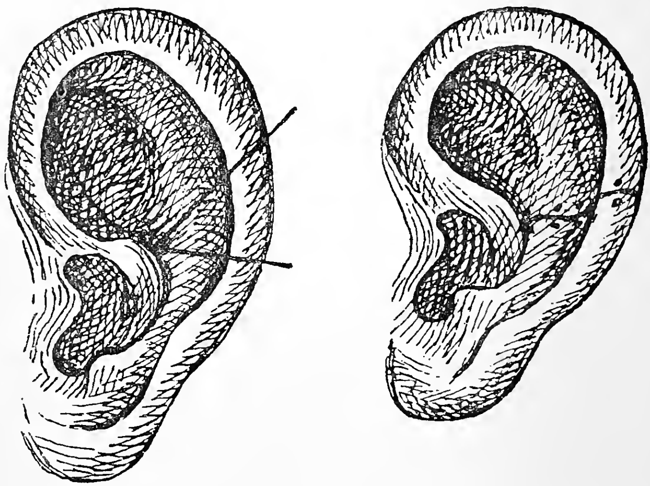
In the first case I removed one of the wires a month after the operation, to observe the effect, and found that in a comparatively short time absorption had taken place, so that the result, though a very great improvement, was not so satisfactory as when the wires are left in place. The ends of the wires may subsequently, or, if desired, at the time of the operation, be cut short and buried through the same puncture and left in position; but I have preferred leaving this to a later stage of the treatment, in case a further elevation of the depression by means of the wire became necessary.

I had thought of attacking the *bones* in the following way, and this plan will be useful in some cases. Two incisions, one on each side of the nose, running obliquely from above down and out were to be made, and the soft parts raised with an elevator, the cartilage was to be then separated from the bones and small cutting forceps used so as to isolate the nasals from the superior maxillæ and frontal, and the bones were then to be replaced with a

pair of forceps, the blades of which were to be protected with india-rubber so as not to injure the skin. Stout rubber tubing was to be introduced through the nostrils to keep the bones in place and for drainage. If needful, one or two stout hare-lip pins were to be passed through the incisions and under the bones, and these were to be supported laterally by oiled pads kept in place by a nasal truss like that shown in the first figure of this chapter. The skin incisions were first to be brought together. Mr. Walsham has devised and figured an apparatus which he says will rectify displaced bones as well as cartilages; but it seems to me that the skin would ulcerate before any impression could be made on the bones. His paper is in the *Lancet* for September 20 of this year.

The Ear.—The deformities of the external *ear* which admit of surgical treatment are not numerous. Supernumerary auricles must be removed. Contracted meatus must be treated according to the condition and cause, and works on aural surgery must be consulted for these. But there are two conditions of the ear which are oftenest seen and best treated in children, and which have come under my notice at the East London Children's Hospital and on a few occasions in private. I allude to external and forward projection of the auricles, and also to the occurrence of large *flap-like* or *donkey-ears.* The former condition is best treated in infants by a piece of strapping passing from the zygomatic arch on one side over the auricles to a similar position on the other, and if this plan be commenced from infancy and continued for some months, the mal-position of the auricles can be remedied. Later in life, a light elastic spring attached to two vulcanite flesh-coloured ears fixed over the natural ones and passing beneath the hair, should be worn for a long time, and then the position of the cartilages will be considerably improved. In some

cases the ears are too closely set, or the lobule is adherent to the skin in part, or in whole. In the former case division of the external aural muscles may be of service, and in the latter an incision, or plastic operation, may be required. In cases where the auricle is turned forwards so as to close the meatus, tense bands of skin or of cicatrix, if



FIGS. 226 and 227.—Martino's operation for large and prominent ear.

these have caused it, must be divided, and the ear maintained in position for some time after healing of the wounds has taken place. In hypertrophy of the external ear, or, in cases in which it is very large, Martino has excised a triangular piece, and subsequently carefully sutured the edges, as shown in the accompanying figures, with a good result.

CHAPTER XXVII.

CONTRACTIONS AND DEPRESSED CICATRICES.

Causes.—These terms sufficiently explain themselves, and are due to destructions of the skin and subcutaneous tissue, sometimes involving the deep fascia, caused by burns, lacerations, and gangrene of the skin. In deep cutaneous destructions the wound is repaired by fibrous material, which is highly contractile, and so powerful is this contraction in some instances that joints may be displaced, bones—especially of young subjects—may be distorted, and, of course, important soft structures dislocated and sometimes involved in the cicatrix, as I have seen them in cases of severe burn of the neck. Every general and orthopædic surgeon of experience must have seen cases of severely deformed limbs due to cicatrical contraction resulting from severe burns, or extensive lacerations, and as such cases are difficult to treat satisfactorily and require much patience, I will devote a little space to their consideration. It must be borne in mind, however, that the growth of cicatrices, especially of the less severe forms, coincides with that of the affected part, and in the milder cases there is some hope from this fact; but in the deeper forms of burn, contraction completely overcomes expansive growth.

Treatment.—In treating cases of extensive or deep destruction of the skin and subcutaneous tissues, the main

object should be to prevent contraction as much as possible and to expedite healing; but it is inadvisable to extend without due care, as the healing process is interfered with, and the ultimate contraction becomes severe. But when cicatrisation has taken place extension should be perseveringly insisted in, so that the new and supple cicatrix may be brought into a proper condition and position, as old cicatrices are very slightly extensile. Multiple skin grafting should always be attempted in cases of severe destruction of the skin, as it is thought that the grafted epithelium gives to the cicatrix a more supple character.

Extension should be gradual and constant, and it is well to accompany this by frequent, active, and passive movements. A properly adjusted instrument should be constantly worn, and gentle frictions with oil and careful massage of the new tissue are often of service. If these means fail, and contraction increase to the production of deformity, operative measures must be resorted to, and these will vary according to the condition present.

Operations.—The object to be attained is to get a lengthening of the contracted part, and this is generally done by subcutaneous or open division of the cicatricial tissue, care being, of course, taken that no important vessels or nerves are divided with the cicatrix. When the gap is filled up there is that much new tissue, but it must be recollected that this has a strong tendency to contract, so that unless extension be continued for a long time the deformity will be but little improved. If the cicatrix be a band, fold, or web, it may be treated by making a perforation at its base, and subsequently dividing the tissues and keeping them well apart, as in one form of operation for webbed digits.

Another plan is to dissect up the new and imperfectly

formed skin, to dissect out the fibrous bands underneath, then to forcibly stretch or overstretch the parts, subsequently bringing the linear skin wounds together and keeping the parts extended during the healing process. Another method is to transversely divide the scar tissue, stretch the parts into position, and bring the edges together as much as possible, so as to lengthen the scar; or the wound may be left open and skin may be grafted on the surface as soon as granulations appear.

Transplantation of skin from the neighbourhood of the cicatrix or from distant parts has sometimes succeeded. It is desirable, as pointed out by Mr. John Wood, so to form the flap that it can be turned in the course of distinct subcutaneous arteries. It is well not to transplant large pieces of skin, as in the event of failure, especially if the skin has been taken from near the cicatrix, the deformity is increased instead of benefited.

Depressed Cicatrices.

When these occur in exposed positions, as on the face, neck, upper part of the chest, &c., they produce unsightly conditions, which, especially in females, are of a mentally depressing nature. Such scars are commonly due to strumous inflammations and abscesses of the cervical lymphatics, or to gum boils and alveolar abscesses opening on the cheek. They may also be due to various injuries, followed by inflammation.

Treatment.—Formerly, the deep adhesions were separated by a fine knife, and it was thought that the blood effused, which immediately after the operation raised the cicatrix, would become organized and so do away with the depression, but very often the blood became absorbed and the depression returned and probably increased as the new

tissue contracted. Mr. W. Adams has devised a plan by which he subcutaneously divides all adhesions, then thoroughly everts the depressed skin, so that the cicatrix remains raised; he then passes two hare-lip pins at right angles through the base of the cicatrix, and retains them in position for three days. He expresses himself as satisfied with the result of this operation. Not being satisfied with cases operated on by this method, because of the subsequent greater or less reappearance of the depression in consequence of absorption or contraction of the new material, I have adopted a plan varying a little from that described in the chapter on nasal depression. It consists in passing a silver wire subcutaneously around the adhesions, making the ends emerge at the same puncture and tightly drawing and twisting the ends together. The adhesions, are thus more or less cut through at the time of the operation, and by giving an extra twist occasionally, the remainder of them will give way. The ends are then cut off close to the puncture and buried in it, and the wire left permanently *in situ*. The new material thrown out as a result of the operation becomes organized around the wire, and the two together prevent the cicatrix relapsing.

APPENDIX.

OSTEOTOMY FOR IRREMEDIABLE EQUINUS.

SOME years ago, in a case of badly united fracture of the tibia in which the foot was fixed in equinus, I corrected the deformity of the leg and malposition of the foot by a supra-malleolar osteotomy and tenotomy of the tendo-Achillis, and it has occurred to me to try this plan in a case of extreme neglected equino-varus now under treatment at the London Hospital.

Whether the idea be original or novel, I cannot say, but it appears to be a proper and hopeful proceeding in otherwise irremediable cases of equinus, and much preferable to excision or osteotomy of the astragalus which, of necessity, leaves a rigid foot.

TREPHINING IN POTT'S DISEASE.

Dr. McEwen, of Glasgow, has opened the spinal canal and removed inflammatory material pressing on the cord. I do not know of any detailed publication of his cases, and cannot, of my own experience, say anything as to whether the proceeding is likely to find a permanent place in Surgery. I do not, however, doubt that some cases may justify the operation, both from the urgency of their symptoms and the ultimate history of the cases. At first sight it seems to me that the spinal canal must remain weakened, but until we know more of McEwen's cases and manner of operating, judgment must be withheld.

ABSENCE AND DEFICIENCY OF CLAVICLES.

The clavicles may be partially or wholly absent. I have seen three instances of this deformity, and two were in males. In one case, seen also by Mr. Eve, at the London Hospital, the inner third of both clavicles was undeveloped, and the free ends formed prominences. In another case the deficiency was unilateral, the inner half being deficient. In the third case, occurring in a girl, the outer fourth or fifth of the bones was

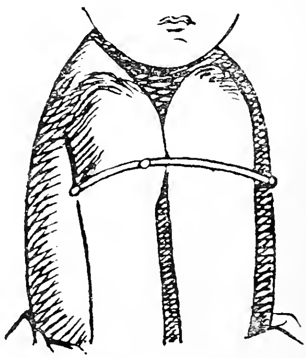


FIG. 228.—Absence of clavicles, showing how the arms may be tied together. (Kammeler.)

represented by ligamentous tissue, which could be felt on movement and manipulation. In these cases much greater forward and backward movement of the arms is possible, and the extent of this will vary with the amount of the deformity. Proper exercises and instrumental treatment, if begun early, will do much to obviate the results of the deficiency.

DUPUYTREN'S CONTRACTION.

During the past few months I have had under observation five cases of this deformity. Two were in females and three in males. Of the former, I showed one case to the class at the London Hospital. It occurred in a washerwoman, aged 52,

and she attributed it to wringing clothes, but seeing that it affected her left hand, and no pressure of any sort came on it during this, and that both hands are used simultaneously for this purpose, her explanation does not seem satisfactory. There was no evidence of gout or rheumatism.

I have recently operated on a lady aged 45, in whom the affection began at the age of 32. The right ring-finger was much bent, and the adjoining fingers were becoming drawn in through processes at their webs. She thinks it may have been produced through falling from, and being dragged some distance by, a horse while holding the reins. Shortly after that she took a hobby for a sewing-machine, which she worked a good deal, and being fond of music practised very often on a *digitorium.* I operated by Hardie's modification of Goyrand's method, excised the greater part of the tense band, and the finger became straight after two loudish snaps, which were doubtless caused by some deeper fibres being ruptured. I was able perfectly to straighten the finger, and the case, up to date, has done admirably, for the wound healed by first intention.

Of the three cases occurring in males, one came under notice at the London Hospital, and two were private. The former occurred in a man aged 31, a hatter from Nottingham, and occupied the right ring-finger. He declined treatment. One of the private cases was a gentleman aged 60, who had observed a thickening of his left palm for about ten years, and attributed it to the pressure of his walking-stick, which he usually carries in his left hand. There is a tense band, not very prominent, and a nodule at the proximal end of the palmar aspect of the metacarpal phalanx. The condition remains stationery, and so I did not advise operation. It is well to recollect that some few cases are of this nature. His habits as regards living are somewhat free.

The last case is unique in my experience and reading. The subject of it is a boy aged 12. His left hand has a distinct band to the middle finger and some nodules in the palm, but in the right hand the scattered nodules are more noticeable than the bands, which are quite rudimentary as yet. The fingers are slightly bent, and complete extension is impossible. At present operation is not called for, so I have ordered inunc-

tions, manipulations, and a light machine, which Mr. Schramm is making for him.

Dupuytren's contraction occurring at this early age, and in a child whese parents are free from gout, and who has never had any great pressure on his palms, is a pathological rarity worthy of permanent record.

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